ELECTRONICS Australia

HIFI NEWS

APRIL, 1975
AUST 80c* NZ 80c

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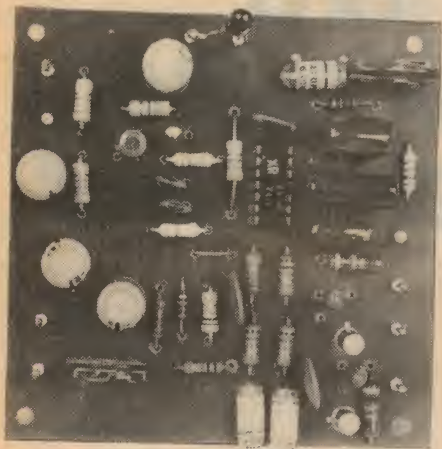
VOLUME 37 No 1



Developed in our laboratory, this simple decoder will allow you to convert your existing mono FM receiver to produce stereo signals of very good quality. Read all about it in our article commencing on page 34.

Expanded from the 2-45L system described in the January issue, our new 3-45L loudspeaker system has exceeded even our own expectations. Full constructional details commence on page 54.

On the cover

The appeal of the latest generation of amateur radio equipment proved too strong for well known identity Dick Smith (VK2ZIP) and Harry Tyreman (VK2BHT/G3SLL), manager of the radio section at Dick Smith Electronics. The pair are shown here operating some of their new equipment at Greenwich Point, Sydney. You will find a more familiar likeness of Dick Smith on the front cover of his latest catalog, presented free inside this issue.

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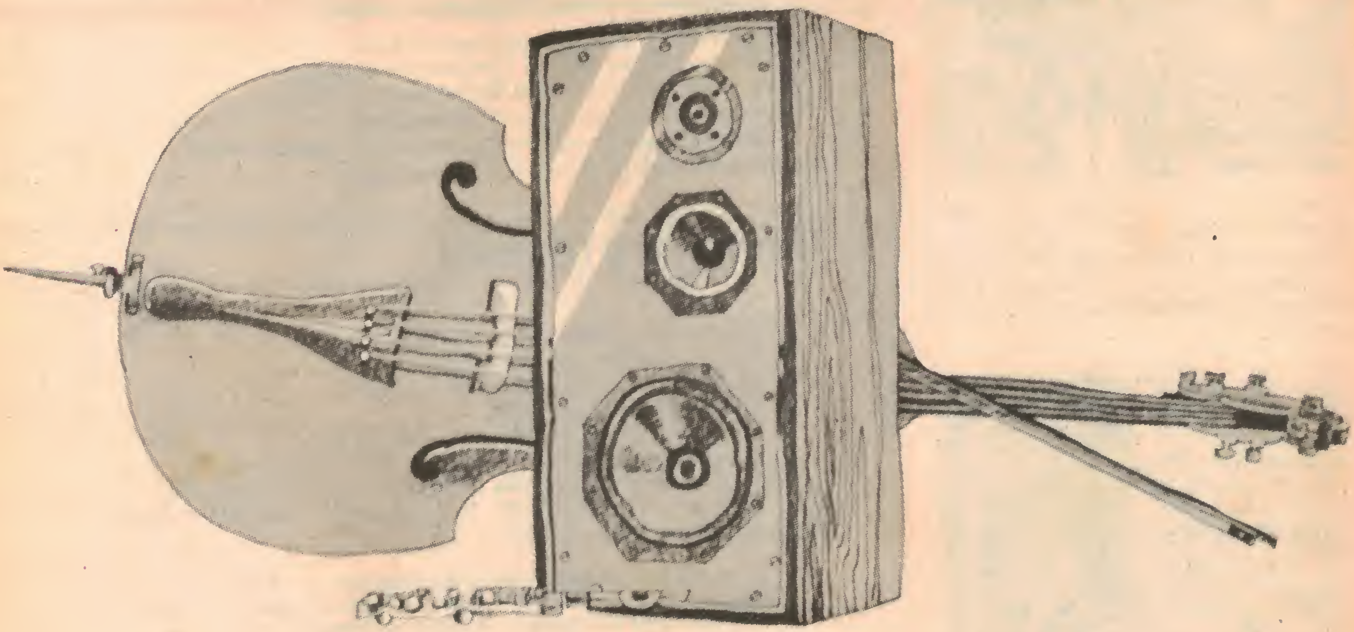
PHILIPS

How can you afford a really good speaker system that has minimal distortion?



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Editorial Viewpoint

Sales tax: What a mess!

Some years ago, when the Australian electronics industry was fairly rigidly divided into manufacturers, importers, wholesalers and retailers, the imposition and collection of sales tax on electronic components may have been fairly straightforward and equitable. But ask virtually anyone involved in component buying and selling, and they'll tell you that nowadays the situation is quite different.

The effect of recent legislation concerning retail price maintenance and restrictive trade practices has been to deal a final blow to what remained of the rigid industry structure on which the existing sales tax system was based. Retailers are now able to buy direct from manufacturers, and can sell at very low prices because they pay tax on their bulk buying price. On the other hand wholesalers, because they do not deal direct with the end user, must charge tax on their small-quantity selling price, and are therefore at a decided disadvantage.

For example a hobbyist can buy small resistors for typically four cents each, or less, from many of our larger advertisers who trade as retailers. But a serviceman buying similar quantities of the same resistors must buy from a wholesaler, where he is likely to pay considerably more. He cannot legally buy from the retailer without paying further tax, because he is not the end user. So both the wholesaler and the serviceman must inflate their prices to compensate, and the end user cops the lot.

Not only this, but there are numerous tales of different firms deducting quite widely varying tax levels on identical components, each on the written authority of tax officials! It is apparently quite commonplace for such officials to contradict one another at different times, leaving the firms to sort out the right answer or risk a stiff penalty.

There's no doubt in my mind that the sales tax system has utterly failed to keep up with changes in the electronics industry and its products. It is now the source of such confusion, injustice and inefficiency that no amount of bureaucratic patching-up will remedy matters. Nothing less than a full-scale revision is required, and urgently.

Perhaps this should become part of a total re-evaluation of the sales tax system as a whole, with consideration given to replacement with a value-added tax system as implemented overseas.

The problem is that ultimately the only people who are suffering from the failings of the present system are the public and a relatively small number of modest-sized wholesalers and servicing firms. Unlike big manufacturing firms and unions, these groups tend to have small voices and little lobbying power. Ralph Nader, where are you?

Jamieson Rowe

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These high-quality BASF magnetic tapes are the result of further development of the well-known lines of LH tape; a development which has gone beyond the already achieved Hi-Fi standard and produced a line of professional quality. The aim and yardstick of all BASF research is the original sound; the pure, undistorted sound of crystal-clear reproduction. Defined in terms of the technical minimum requirements according to Hi-Fi standard 45 500. Heightened to meet the stringent demands of the professional studios. With this professional tape, we have satisfied all the requirements of those spoiled musical aesthetes as well as of the critical tape fans. This is a tape whose important facets you should get to know.

The profi-tape:
New: The conductive matt reverse side. Strikingly matt black, also on the leader tape.

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The profi-spool:
New: Profi design in metal or plastic.

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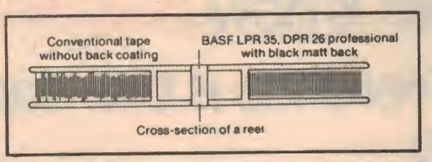

Cross-section of a reel

New: Binder-oxide system.

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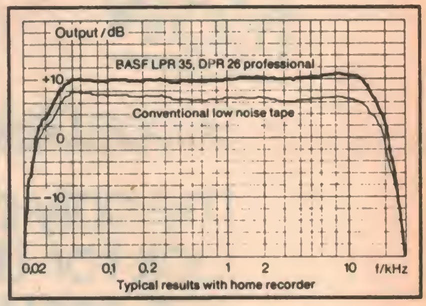

Typical results with home recorder

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Hi Fi News

UD4: another 4-channel system

It looks as though the high fidelity industry is going to get what, superficially, it seems to need least: another quadraphonic system. That's the bad news. The good news is that the proposed system might turn out to be the common-sense compromise that the industry could have had, and should have had, almost from the very start.

by NEVILLE WILLIAMS

During 1971, the major Japanese hifi companies were all engaged in a cloak and dagger operation to ready themselves for what promised to be a revolution in hifi listening: 4-channel sound. Seeking to gain an advantage over rival companies, the mood everywhere was one of secrecy rather than cooperation, with the inevitable result that a variety of "standards" emerged.

Admittedly, the systems were later rationalised to some extent but the industry is still saddled with three – which is about two too many!

Two of the systems are based on the matrix principle. The four signals, which might be defined as belonging to front left and right and rear left and right, are merged into two channels which are then recorded on disc or tape as a stereo pair. The phase and amplitude of the respective signals is carefully manipulated so that, during playback, the four signals can be separated out again, at least partially.

The essential difference between the two matrix systems is the relative amplitude and phase relationships between the component signals. A group led by Sony and American Columbia opted for a particular set of parameters and christened their system "SQ". Another group headed by Sansui came up with an alternative "QS" system; a slight variant from the QS parameters produced the "RM" (Regular Matrix) and this is now supported by most companies which do not want to do things the Sony-Columbia way.

Despite their differences, the matrix systems have this much in common that they make no really new demands on the record/playback system. They involve only two information channels of purely audio frequencies and, in this respect, are no different from a normal stereo disc or tape. The user simply takes the signal provided by the playback device and passes it through a more complex audio system feeding four suitably positioned loudspeakers.

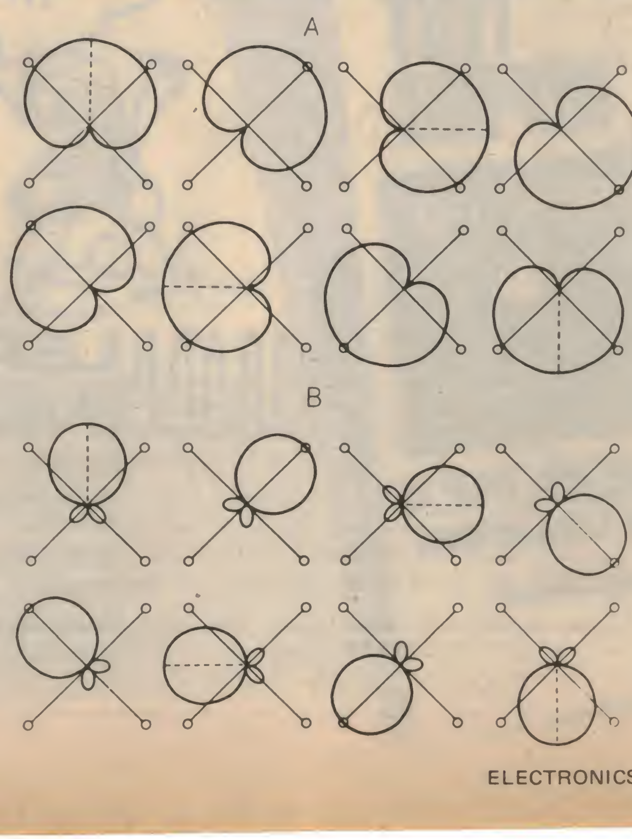
In fact, the matrix quadraphonic system has a high degree of compatibility with existing equipment. A matrix quadraphonic record can be played on a 2-channel stereo or mono player and will produce a substantially normal 2-channel or mono result. Alternatively mono and 2-channel stereo discs and tapes can be played through 4-channel matrix equipment with, many listeners say, enhanced spread and musical interest.

Compatibility with existing records and equipment is the strong point of the matrix system. For its proponents, it is unfortunate that their own approach to it is divisive.

While many companies were working on matrix systems in the 1970/71 era, another major grouping (JVC Nivico in Japan and RCA in America) had decided that the price for compatibility was too high in terms of compromising the end result. While a matrix quadraphonic record could indeed be played on a 2-channel system, sounds intended to reproduce strongly from the back channels can suffer considerable attenuation. Played on mono it can be even worse, with some sounds liable almost to disappear—a vital consideration in the vast context of AM broadcasting.

No less important, JVC and RCA maintained that the matrix system was incapable of adequate separation between the respective channels. At best, it would be capable of "surround" sound or, with the help of automatic gain control, of emphasising isolated dominant sounds in popular recordings. In no way would it be able to recreate pure ambience, as appropriate for classical concert programs.

So JVC and RCA chose the hard road. Their CD-4 system uses the main stereo tracks on a disc to carry a genuine left-plus-right "sum" signal, which loses little or nothing when played back as 2-channel stereo or mono. But the groove also contains a supersonic carrier frequency modulated with the "difference" signal between left and right. By using a special cartridge with a response to about 45kHz and a special decoder, a high degree of separation between all channels is pos-



According to reports, the symmetrical phase matrix used for the UD-4 "sum" signal can produce the directional polar diagrams shown under "A" (left), when resolved only through Nippon Columbia's BMX matrix decoder. When reinforced by the supersonic difference signal (full QMX discrete decoding) the polar diagrams are much more sharply defined as under "B". Speaker amplitudes are indicated by the length of the diagonal within the polar diagram.

sible, allowing the system to cope with music of any kind—quadraphonic musical pang-peng-ping-pong or classical plus ambience.

The chosen course indeed turned out to be the hard one for JVC and RCA. While critics have generally agreed that CD-4 is the system with the greatest potential, the task of designing, proving, producing and marketing both the equipment and the records has proved to be a formidable one.

One other aspect of CD-4 equipment has operated to its disadvantage. While it can play mono and 2-channel records to full advantage in 2-channel mode, it lacks the matrix circuitry which allows the other systems to produce an artificial—but often pleasing—"surround" effect from such records. And while the inclusion of some kind of a matrix would be a relatively simple addition, the proponents of all the rival systems have tended to take the hard line: our system and ours only!

To be sure, some manufacturers do now provide for all systems in their more elaborate equipment but enough of the hard line is still there to unsettle the prospective purchaser.

During the early stages of the matrix/CD-4 battle, a number of commentators, including the writer, lamented that the contestants had not pooled their resources in order to evolve a more universal and less contentious result.

For example, JVC/RCA could presumably have adopted a modest form of matrixing for their main sum signal, which would have allowed their discs to be decoded to a limited extent using a simple matrix type decoder. Equally, the matrix interests could have cooperated in planning an optional supersonic component that could be used in more elaborate equipment to reinforce the separation.

But there the suggestion seemed to have ended. All parties were too heavily committed to change course.

Recently, voices have been raised in Britain, in particular, in support of another distinct approach to spatial sound, which is referred to as "ambisonic". Its proponents roundly condemn all existing 4-channel systems, the automatic use of a loudspeaker in each corner and the use of multiple microphones and complex mixing techniques to produce an "arbitrary" mix-down.

The ambisonic principle flows from the idea of using a single multi-element microphone in an optimum listening position, and seeking to encode and record the intensity, phase (and directional) qualities of the total sound that reaches that "listening" position. For subsequent recording, transmission and playback, you arrange matters with a view to retaining and recreating as much of the information as the available channels and equipment will allow. This does not automatically mean a loudspeaker in each corner.

4-CHANNEL, AM-FM FROM PIONEER

Typical of the fully equipped 4-channel systems currently available is this new Pioneer FD-3 quadraphonic stereogram, which sells for just under $1000. It has in-built facilities to decode both RM and SQ matrix recordings, as well as CD-4 discrete. An AM radio tuner is included, as also an FM/stereo tuner, both operating in conjunction with a tuning meter, and both providing an adequate level of performance. The turntable is an automatic single-play unit, with cast alloy turntable and belt drive. The amplifier has full control facilities, with connections for microphone and tape equipment and an output capability of 30W continuous total, with all channels driven. Both loudspeaker systems are two-way; at the front is a 20cm woofer with dome tweeter while the rear enclosure houses a 16cm woofer and 10cm cone tweeter. (Details from Pioneer Electronics Aust Pty Ltd, 256-8 City Rd, South Melbourne 3205, or branches in other capitals.)

Ambisonics seemingly faces an up-hill battle. It has left its run very late and the major recording concerns do not seem to be taking it too seriously. In fact, in the studios, there is considerable misgiving about the single "listener" microphone concept for anything other than the purist concert situation.

Producers of popular records, whether 2-channel or 4-channel, like their multiple microphones and the degree of flexibility that the technique offers them.

No less important, the proponents of ambisonics seem to be strong on criticism and maths but weak when it comes to explaining the system to anyone other than their technical peers. To the average hifi reader—and writer—it remains something of an enigma: an almost academic exercise.

All this wrangling and uncertainty has had its effect on the saleability of quadraphonic equipment in the marketplace. In part, it is due to a direct impact on the buyers, who are tempted by an innovation but deterred by lack of agreement about its merit, as well as by the additional cost and complication.

No less important, it provides the perfect reason for hifi dealers to be conservative, and to go on selling what they are most familiar with—conventional 2-channel stereo. A common attitude on the sales floor seems to be: "We have 4-channel equipment and we'll sell it to you if you really want it. But, getting back to normal stereo . . ."

The quadraphonic concept may indeed need a new image if it is to break through this kind of resistance.

The new scheme on the 4-channel horizon referred to at the outset is the UD-4 system being put forward by Nippon Columbia. One would assume that

UD-4 stands for Universal Discrete 4-channel. And universal it certainly is—combining the best aspects of both matrix and CD-4, as suggested earlier and drawing upon subsequent experience and research.

Like CD-4, the UD-4 system provides a main channel stereo pair which carry a "sum" version of front and rear signals. Similarly, it provides for a supersonic carrier modulated with a front/rear "difference" signal. But there are important distinctions between the new system and CD-4.

The main stereo signal is summed through a matrix similar in concept to those used in the purely matrix systems. At an economy level, the record can be treated as a matrix disc: played in mono or 2-channel stereo on ordinary equipment, or in 4-channel mode with the separation that one expects from a matrix disc. Equally, UD-4 matrix replay equipment can synthesise surround sound from ordinary stereo material.

If the user so elects, he can instal a more elaborate playback system capable of resolving the supersonic difference signal. This will reinforce the separation already provided in part by the matrix, to produce the high degree of separation expected of a true discrete system. The end result is a single format disc, which can be replayed or broadcast at a technological level determined by the user's equipment.

It represents, in fact, the universal approach which commentators were calling for, almost from the outset.

In putting forward the method now, Nippon Columbia can, of course, apply the lessons which have been learned in the meantime.

There is a strong hint that the engineers behind UD-4 (Dr D. H. Cooper, USA; Dr T. Shiga and Dr T. Kagaki, Japan) have been influenced in their thinking by the Ambisonic school, in their formulation of the basic matrix. Described as the "phase symmetrical BMX matrix", it differs from both SQ and QS/RM. The claim is that, while providing the required broad directivity in 4-channel matrix mode, it makes better use of the recorded signals in 2-channel or mono mode, than any of the existing matrix systems.

With directivity already partially established by the matrixed main channel signals, the supersonic difference signal merely has to reinforce the spatial pattern by out-phasing the cross-talk rather than the total sum signal. According to Nippon Columbia engineers, demands on the difference signal are much reduced. The full 15kHz bandwidth is not needed and, in effect, bandwidth can be traded for better signal/noise ratio. The benefit is of such an order that automatic noise limiting can be dispensed with or, at most regarded as a luxury option.

Reducing reliance on the difference signal is credited with other practical advantages. Slight mistracking, amplitude and phase errors are all diminished in their impact on the sound as heard and, according to Geoffrey Shorter, Technical Editor of "Wireless World", UD-4 records and equipment give the impression of being "effortless".

Logic circuitry becomes superfluous. While it could operate with the new "BMX" matrix it would suffer the limitations of all logic and similar systems in being able only to deal with isolated dominant signals. If a better result is required from UD-4 recordings, the money should be spent on exploiting the supersonic carrier which will produce true discrete rather than the contrived and inadequate variety.

Disc manufacturers would themselves have a degree of flexibility. They could produce matrix-only recordings suitably identified, where this seemed commercially appropriate: the supersonic circuitry of full discrete equipment would remain inoperative. But, hopefully, most quadraphonic discs would carry the supersonic difference signal, thereby realising the full capabilities of the system.

Nippon Columbia have produced pilot equipment and recordings sufficient to demonstrate the promise of the UD-4 approach. Because their decoder contains both matrix and supersonic circuitry, they have been able to make it switchable for the older SQ, QS and CD-4 systems. But obviously Nippon Columbia are hoping that the need for these extra facilities will ultimately disappear.

Has UD-4 appeared on the scene too late? Maybe not!

The buyer of a UD-4 decoder could still enjoy synthetic stereo from his conventional records and play his other-system matrix quadraphonic—without necessarily being aware that it is "surrounding" him in a somewhat different way. The biggest gap may be the one between UD-4 and CD-4 but it may not be entirely hopeless and it would affect fewer people anyway!

INFRA-RED DIODES DRIVE PHONES

Cordless headphones are not an entirely new idea, signals being conveyed to them on an RF carrier or, more commonly by audio induction from a loop around the listening area. But Siemens have come up with a quite novel approach involving modulated infra-red light and luminescent diodes. Their news release reads as follows:

Siemens has now introduced a diode for the wireless transmission of entertainment sound in the home; appliance and headphones are linked by invisible infrared light, transmitted and received by diodes, so that wearers of headphones need no longer be tied by lines to their radios and record players.

The heart of this special optelectronic system is a new photodiode (BPW 34) with an active area of $9mm^2$ which is installed in the headphones and picks up the frequency-modulated signals (over 100 kHz max.). The transmitter comprises a maximum of eight luminescent diodes (LD 241) capable of supplying a total power of 120 mW, which is adequate even for large rooms.

On account of its physical characteristics, infrared light is particularly suitable for the electronic "flooding" of rooms. Neither dark nor rough areas can absorb the radiation or distort the impressed intelligence signals. Protruding edges of furniture also have no effect on the high fidelity quality of reproduction. The infrared light is diffuse and stochastically distributed throughout the room. The headphones do not have to be trained in one particular direction.

During the development stage of the silicon photodiode BPW 34 particular attention was paid to achieving the smallest possible inherent capacitance and thus a high cut-off frequency, despite the relatively large receiver area of $9mm^2$. With frequency modulation the component could operate, for example, with a carrier frequency of 100 kHz and a band width of 50 kHz. A filter layer ensures that the diode only receives infrared light and thus converts no other light into electric pulses. The diode is housed in a transparent plastic cover with pointed solder terminals for ease of insertion. In addition to this cost-effective version there is also a professional version (BPX 61) accommodated in a hermetically sealed metal case.

The transmitter elements are the luminescent diodes LD 241. The original plan was to use single components, but it was discovered that impedance matching is less complicated with an array of smaller diodes. A peak power of 60 mW can be achieved with four LD 241 diodes for medium-sized rooms. Eight diodes supplying 120 mW should be adequate for a small hall.

The transmission of radio and TV sound and records to headphones using infrared light is not restricted to domestic usage. With simple optical means ranges of a few dozen meters could be achieved. As a transmission medium infrared light can also be used for multichannel remote control systems working without wires. Cableless headphone sets for entertainment devices could be on the market within a very short time.

For further information contact Siemens Industries Limited, 544 Church St, Richmond, Vic 3121, or in other major cities.)

FROM A HIFI IDEAL TO A SONIC EARTHQUAKE

One of the notable features of Universal Pictures' recent film "Earthquake" is the tremendous low frequency acoustic power unleashed by the special sound system. Responsible for much of the technology is an engineer and a product line dedicated to the big sound concept—a product line soon to be launched on the Australian market.

by NEVILLE WILLIAMS

Thirty years ago, Gene Czerwinski was just another American engineer-in-the-making, who had developed a strong personal interest in music and sound reproduction. And, like many others in such a position he was convinced that, given the opportunity, he could produce better microphones, better amplifiers and better loudspeakers than those currently available on the market.

But these early convictions had to take second place to certain practical commitments—like completing his university education and serving a stint in the US Navy! There was also the matter of earning a living, but significantly, this took him to Los Angeles, then—as now—the focal point of the US professional audio industry. By day he worked at aerospace electroacoustics; by night he pursued private audio research.

In 1954 Gene Czerwinski took the plunge and formed Vega Associates. It did well and he gradually withdrew from aerospace activities to concentrate all his efforts on the new venture.

At the time, domestic music systems were monophonic and a cherished aim of enthusiasts was to obtain a generous sound, with strong foundational bass and an impression of breadth and dimension. Accordingly, the first offering by the new Vega company was their model 500—a 4-way system incorporating an 18-inch woofer and using wall reflection and corner coupling to spread the sound and produce a level of 130dB down to 30Hz.

This was followed by smaller systems (down to 12-inch woofers!) but all with the same emphasis: high power, high sensitivity, sustained bass response and maximum spatial effect. These were joined, in 1957, by the Vega solid-state amplifier, with a whopping (for then) 125W RMS power rating and an output stage that did without a transformer and fed directly into loudspeakers of normal impedance. In fact, Vega claimed it as the first-ever transformerless domestic hifi amplifier.

Then came 1958 and stereo, and it proved to be a sorry development for Vega. Suddenly, hifi interest shifted to "ping-pong" and spatial effects derived from two tracks, two amplifiers and two loudspeakers—and there simply wasn't room in the average home for two of the Vega style enclosures.

Make smaller systems?

Vega could undoubtedly have joined the trend towards more compact systems but, at the time, Gene Czerwinski was unwilling to abandon the design philosophies he had worked on, even in the face of falling sales.

Fortunately, the company was able to find alternative outlets for its products and know-how. While continuing to produce and supply precision studio systems, it turned to the burgeoning music making market where performers were calling for bigger and better amplifiers and loudspeakers to couple to their instruments and microphones.

By the early 70s Vega dominated the market for high powered speakers used by groups and bands across America. To this they had added high powered PA amplifiers, consoles and sundry other equipment to the point where they had become the recognised specialists in public address on a grand scale—50kW and 100,000 people—at venues such as the Los Angeles coliseum.

With such a reputation, it was not surprising that the company—now Cerwin Vega—should be a candidate for consideration in a new venture that was being examined, a couple of years back, by the directors of Universal Pictures, of California.

Always on the alert for ideas that could outsmart the television "box", Universal's

Vice-President Jennings Lang had come up with the idea of a super spectacle based on the uncomfortably topical theme of the total destruction of Los Angeles by earthquake. With camera tricks, colour and a wide screen, the visual side could hopefully be highly spectacular—but it would be routine in terms of today's technology.

The same would apply to the scripting, the musical score and the use of multitrack surround sound, standard in a great many theatres. Universal's objective was to get rid of that word "routine".

The innovation they had in mind was accompanying sound, so low in frequency, and of such amplitude, that it would produce for the audience the physical sensations of being involved in a real earthquake. The problem was whether it could be achieved and, if so, without hazard to the audience.

Two of Universal's sound directors, Richard Stumpf and W. O. Watson had been reminded of Cerwin-Vega's involvement in big sound at a previous A.E.S. (Audio Engineering Society) convention and it seemed likely that they would be in a better position than most to help Universal's engineers provide the practical answers for such a proposition.

First off, they had to find out what they could about the nature of the sound to be reproduced, and how the sounds could be recorded and subsequently propagated in theatres.

Meanwhile, Universal's legal staff had to look carefully at the company's possible liability for damage to theatres or trauma for patrons—whether real or merely alleged.

Information on the basic sound came from tape recordings made during the intense Sylmar earthquake that rocked California in 1971. Signals on the tape were subjected to spectrum analysis and a pseudo-random noise generator was devised which would produce a similar signal to order, free from the restrictions and incidental noises that would characterise an actuality tape recording. Frequencies below about 16Hz were ruled out on the basis that: (1) Propagation would have been extremely difficult technically; (2) they could pose a structural hazard to theatres; (3) they were unnecessary for the audience sensation.

Even with this concession, it was obvious that the desired earthquake noise could not be recorded directly on the film soundtrack for reproduction through the normal theatre system—even if augmented. Motion picture standards specify a deliberate low frequency roll-off—which is questionable by ordinary hifi standards. It would have completely defeated any attempt to produce high output levels at frequencies which are sensed rather than heard.

As a result, Universal decided that exhibitors would ultimately have to be provided with an appropriately tailored electronic noise generator and that the film would carry a control signal that would cue the generator on and off as necessary. Further, that all theatres exhibiting the "Sensurround" version of "Earthquake" would have to be provided with a high-powered amplifier system completely separate from the existing installation. This extra system would provide the low frequency "earthquake" energy and, for good measure, could reinforce some of the incidental booms and crashes.

In due course, Universal's own screening room re-echoed and shuddered to the sound of "noise" frequencies from 60Hz down, produced by a mixed bank of Cerwin-Vega standard 48-DD concert horns (18-inch woofers and 32Hz rating) and prototypes going down somewhat further. Driving them was a bank of 1200W concert amplifiers.

These preliminary experiments went on for three months, using a demonstration reel made up of some of the early "Earthquake" footage and, as audience, some of the thousands of tourists who regularly flow through the Universal film lot outside Hollywood. Demonstrations were also conducted in New York and Brazil, further to observe the reaction of audiences exposed to this new experience.

With peak sound pressure levels in excess of 120dB inside the theatres, and with everything from partitions to seats vibrating convincingly, the audience reaction was sufficiently encouraging to win the final okay for a $30 million budget covering three films based on what had come to be called the "Sensurround" concept.

From the tests emerged the broad specifications that Cerwin-Vega had to meet as the principle suppliers of the basic hardware: An amplifier system that could be adapted easily to the needs of a wide range of theatres throughout the world, and capable of projecting predictably a bass level of 110-120dB, with fundamental components down to about 16Hz.

Universal planned to purchase the equipment for lease to exhibitors, along with all "Sensurround" prints.

To RCA went the job of setting up the theatres and instructing operators in the correct use of the equipment.

It is interesting to re-express this venture in terms familiar to a hifi enthusiast:

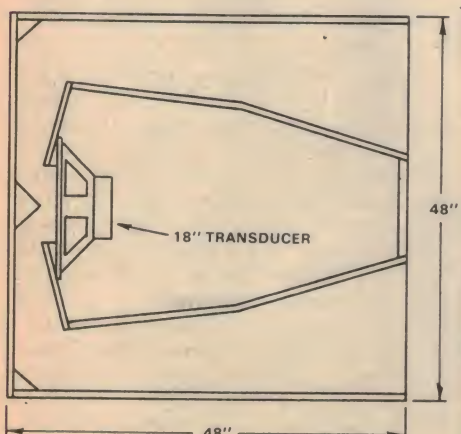
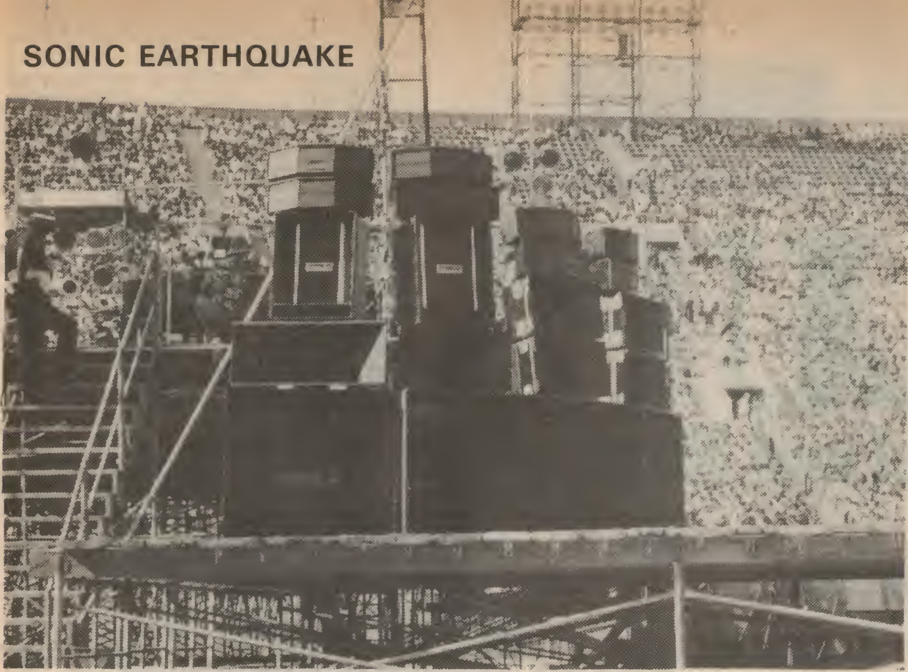


Fig. 1: The basic horn configuration chosen for the super-bass radiators. At right: Two of the units fitted with extension flares, suitable for vertical stacking.



One of four loudspeaker stacks used to cover the 100,000 seat Los Angeles Coliseum. Total audio driving power used on this occasion was 50,000 watts (RMS) supplied by a bank of Cerwin-Vega amplifiers.

In a home he may typically use about 10W RMS and an acoustic suspension loudspeaker system to set up a 90dB sound pressure level in a 3000cu ft room. In so doing, he will accept a roll-off below about 50Hz which will diminish the response at 16Hz by 20dB or so. If he wished to produce a sound pressure of 90dB at 16Hz (neglecting room dimensions, etc) that 20dB roll-off or 100 times power loss would have to be made up somehow: 100 identical systems; 10 systems, each with 10 times the power at 16Hz; or a combination of more systems, higher power and higher bass-end efficiency!

And remember, this is in a 3000cu ft living room with only a 90dB sound pressure level.

Now translate that requirement into a theatre with, say, 50 times the airspace; and allow that the basic requirement is for an SPL of at least 110dB, which represents a further increase in power level of 20dB or 100 times!

Carried to a thoroughly impractical extreme, such calculations would indicate that, even allowing for mutual coupling between stacked woofers, literally thousands of domestic hifi systems would be needed to produce the desired acoustic power levels. The amplifiers would consume hundreds of thousands of watts and the end result would still be output characterised by heavy frequency doubling and other disortion components.

While an extreme case, this cumulative problem was not news to Cerwin-Vega, in their high power installations of various kinds. In no sense can they be regarded as an extension of ordinary hifi thinking.

For a domestic situation, the designer has considerable freedom to trade loudspeaker efficiency for amplifier power output. Indeed, many modern hifi loudspeaker systems are quite inefficient acoustically, even when compared with their earlier counterparts. It is simply accepted that such systems must be used with higher powered amplifiers, typically 50 or 100W RMS per channel.

But once outside the relatively narrow parameters of a domestic hifi installation, the various factors and compromises have to be re-assessed. Cerwin-Vega have traditionally sought to achieve the highest practicable acoustic efficiency in their loudspeaker systems, saving literally kilowatts of driving power in a large installation. This efficiency objective is evident in the design of all their basic drivers, and their preference for horn loading wherever it can be arranged.

For the "Earthquake" project, large and efficient drivers with some form of horn loading seemed to be an automatic choice but this merely highlighted the overall logistic problem.

Universal Pictures were thinking in terms of about 500 installations in theatres—with about as many different sets of dimensions! Custom designed installations would be out of the question, so that Cerwin-Vega had to think in terms of modules which could be variously dispersed and stacked according to the space available in each individual auditorium. More than that, advantage would have to be taken of available corners and surfaces to extend the effective horn dimensions.

Ordinary enough in a small picture, this is really an 18in woofer carrying, in some versions, a power rating of 1000W!

The end result of all this was a basic folded horn, as illustrated in Fig. 1, measuring overall about 48in x 48in x 20in. An 18in driver faces the rear of the cabinet, operating into a constricted area, but expanding into twin flares which ultimately occupy most of the opposite face of the enclosure. The chamber formed between the twin flares provides rear loading on the cone. Complementing the throat design, it provides a means of maintaining some load on the cone, guarding the driver against damage which might otherwise result from excessive cone travel.

In the theatre, the person responsible for the installation has to choose a location for the loudspeakers where the horn will be continued by adjacent walls, such that a wavefront can be developed at 16Hz or thereabouts. Probably the ideal situation is where multiple loudspeakers can be stacked up to 4-high in a vertical line, with the mouths venting into a corner formed by two walls and the floor.

Where suitable corners are not available, it becomes necessary to stack the enclosures vertically against a plain wall, or to lay them in a line along the floor. Either way, with only one side of the horn extended, it is necessary to extend the other by means of an extra wooden panel or flap. And, of course, it is also necessary to ensure that nearby patrons do not cop more than their fair share of the action!

The designers had to accept that such horn structures would be a compromise and that, while the ideal was a flat response to 16 or 18Hz, they would have to accept a higher cut-off in some cases, and severe lumpiness in others. The saving factor was that the signal source was electronically generated noise and, within reason, neither of the above factors would defeat the required sensation.

Even to a hifi enthusiast from way back, the specifications of the basic 18-inch driver are mind boggling:

During final testing, each unit is exposed to a "burn-in" run at 20Hz at an input power of 600 watts. This, in free air. During the test, cone excursion is about 1½ inches peak to peak, resulting in an air displacement of about 300 cubic inches per cycle—comparable to that of a reasonable size automobile engine.

The normal working level in a Sensurround situation is at 300W average power input, with a high peak to average ratio: this for a driver with a basic acoustic efficiency several times higher than the usual domestic hifi woofer.

But, with all their experience in building high-power drivers, Cerwin-Vega found themselves facing problems with the Sensurround project. They could produce voice coil assemblies that would cope with 1000W input indefinitely—without electrical burnout—but none of their existing cones, surrounds or spiders

new Sansui stereo

VALUPAKS

Mk.1 and Mk.11 !

Here's a new and inexpensive all-Sansui stereo system — the Sansui Valupak. All the components are fully compatible — they're designed by Sansui to function perfectly with one another.

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THE SANSUI AU-101 STEREO AMPLIFIER.

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Inset: Sansui Model 441 AM/FM Stereo Receiver

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This includes:—

THE SANSUI AU-101 STEREO AMPLIFIER.
● Total output — 30 watts RMS.
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THE SANSUI SR-212 TURNTABLE/SOUND SOURCE. ● Belt drive. ● 12" platter. ● Large synchronous motor for absolute speed stability. ● Automatic return. ● Precision Sansui tone arm. ● Wide range Sansui induced magnet cartridge — 20-20,000 Hz. ● Teak base, acrylic cover.

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We believe the word *"inspired"* describes Sansui's latest speaker system admirably. It's a 2-way system with a 20 cm bass speaker and a 6.5 cm HF reproducer. Size of the beautifully veneered enclosure is 22⅞" x 13" x 10$\frac{5}{16}$". Range is 35-20,000 Hz. and power handling capacity is 40 watts peak. This new Sansui speaker system will handle the outputs of small, medium and large amplifiers with almost unmeasurable distortion. The AA100W is another Sansui design break-through!

SANSUI MK. II VALUPAK.
The turntable and speaker systems are identical with the Valupak Mk. I. However, instead of the AU-101 stereo amplifier, Sansui includes:—

THE HIGHLY SENSITIVE MODEL 441 AM/FM STEREO RECEIVER.
This all-new stereo tuner/amplifier from Sansui sets new standards for selectivity and sensitivity. It's designed to receive Australia's new FM transmissions *in stereo*, as well as all the Australian broadcast AM stations. Power output of the power amplifier is 22 watts RMS, and frequency response is 25-30,000 Hz. +1, −3 dB. The 441 features Sansui's CBM modular construction — which permits the use of high-density integrated circuits and other Sansui electronic advances in circuit design. Recommended retail price of the Sansui Valupak Mk. II is $699.

We've given you a brief outline on Sansui's Valupaks Mk. I and Mk. II. You can hear the startling difference Sansui quality makes when you listen to these Sansui units at your nearest specialist hi-fi store.

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SV1—175

could take the physical punishment for too long. They had to come up with modified materials and new treatments before the failure rate dropped to an acceptable level.

To round off the whole project, Cerwin-Vega also had to organise apppropriate amplifiers. One obvious proposition was to perpetuate early special designs using very high power transistors, but inherently limited to a power bandwidth of about 1kHz. While adequate for the Sensurround system, such amplifiers would have been useless for any other role.

Ultimately, the company decided to major on a general purpose hifi stereo amplifier already in the prototype stage, and capable of delivering 750W RMS per channel into 4-ohm loads. In its final form, the "A-3000" amplifier includes two important provisions to protect it against damage in high power situations, Sensurround or otherwise. One is the inclusion of special circuitry to limit its slew rate and restrain the destructive effect of very high amplitude transients. The other is a limiting circuit that senses output current and also output voltage developed across reactive loads, by combining the two sets of information, the drive signal can be instantly limited or removed whenever the output voltage/current product looks like crossing the safe-area limits.

So the loudspeakers will stand up to the battering dealt out by a Sensurround earthquake; and the amplifiers are protected so that they always operate safely . . .

But how safe is the structure of the theatre itself, and the patrons?

Research by an engineering group indicated that the risk of structural damage was negligible, even in old theatres. The anticipated sound pressures down to 16Hz would certainly vibrate fittings, seats and partitions, and create the impression of a great deal happening. But the main structure, with resonant frequencies invariably below 6Hz, wouldn't respond to any significant degree.

As far as patrons were concerned, their bodies and particularly their diaphragms would vibrate along with the furniture, and there could be some transitional disturbance of their inner-ear balance mechanism, but this would simply be part of the total sensation. Ears would not be endangered and the planned exposure periods were well below those where longer term disturbance might be expected.

And that's the way it seems to have worked out in practice.

The film is currently being shown in a number of countries, including Australia, ostensibly without unpleasant repercussions. Audiences have been startled, even disturbed, but there has been no talk of pain or panic. Nor has there been any hint of structural damage. Doug Crouch of "Audio" magazine summed it up this way: "Earthquake sound is all that it is cracked up to be!"

CERWIN-VEGA NOW IN AUSTRALIA

Coincident with the release of the film "Earthquake", Magnecord International Pty Ltd announced that they would be marketing the Cerwin-Vega range of loudspeaker systems in Australia. It will include units for both the professional and domestic hifi market.

The professional systems are a natural spin-off from Cerwin-Vega's involvement in America, over many years, in the music-making field, high power public address and, more recently, the "Earthquake" project. As the newly appointed Australian distributor, Magnecord International will be importing systems to meet local requirements, and arranging an appropriate outlet for marketing and service.

One product which came directly from "Earthquake" technology was a new "Super Earthquake" horn, slightly larger than the original unit and with a woofer which relies much less on excursion limiting to protect it from over-excursion and bottoming. It is 2dB more efficient than the earlier model, has a 4dB increase in output level, lower distortion and a frequency range virtually flat from 20-250Hz. It should add a new dimension to electronic organ reproduction and ultra-wideband sound reinforcement.

If this were the end of the story, it would be of little practical interest to local consumers, for not too many could afford either the space or the outlay for units of this class.

However, just as Cerwin-Vega had opted out of the domestic market around 1960, just as deliberately, they opted back in again in 1972, with a complete range of "Residential" loudspeaker systems. They are along conventional lines in the sense that they are rectangular shapes, large and small, styled to fit in with a domestic decor. The external differences between them and other systems is no greater than the usual brand-to-brand variation.

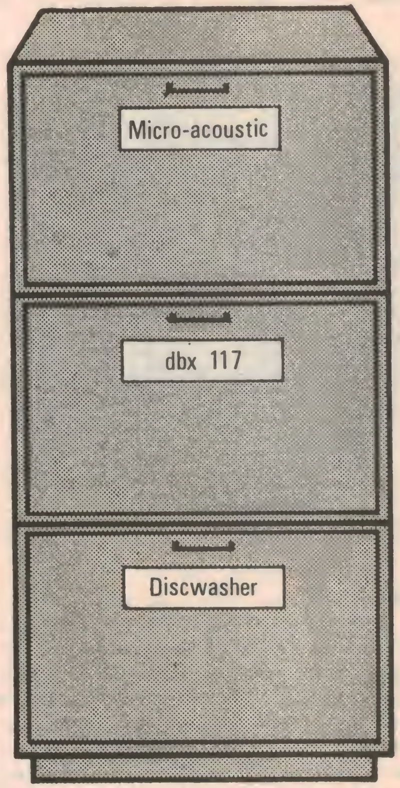
Cerwin-Vega literature indicates that there are about 15 models in the Residential range, from a generously proportioned "shelf" model to large free-standing systems. Most, if not all of the models will be available in Australia, with price tags from a low of about $300 per pair to $2600.

Cerwin-Vega claim that high acoustic efficiency is a feature of all their Residential systems, as compared with other typical competitive units. To what degree this cuts across current system theory has yet to be clarified, at least on the local scene. Sufficient to say that their model 211R is credited with a sensitivity 10dB better than almost any rival system, needing only 5W RMS to produce a high signal level. Yet it is rated to accept 100W RMS, producing an output level of 116dB "undistorted". And the rated frequency range is 32Hz to 20kHz, plus and minus 3.5dB.

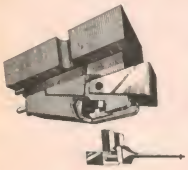
The Residential range of Cerwin-Vega systems will be marketed through selected hifi dealers but, in the meantime, further information is available from Magnecord International Pty Ltd, 276 Castlereagh St, Sydney 2000.

Pictured at the head of the page is the "residential" model 432R with 18in woofer and 300W rating. Above: a display of the drivers used in Cerwin-Vega systems but not available on the market as separate units.

JUST FOR THE RECORD...



Records give you hour upon hour of enjoyable entertainment, transporting you through sound to any country on earth you wish to go; bringing the world's greatest artists to *you*—right inside your living room. Here are three wonderful things you can do for them.



MICRO-ACOUSTIC

The new QDC.1 Stereo Phono cartridge achieves the seemingly impossible: to make a well recorded LP sound like its master tape. Here's how. First, the series 300 styli are shaped and polished with ultra precision to enable them to follow the complexities of the record groove with greater tracking accuracy.

Second, the stylus bar is directly attached to its transducer, eliminating losses inherent in Standard flux field coupling. Result—faster response time.

Third, the QDC.1 stylus is balanced by two elastic bearings positioned to provide precise 45°-45° signal resolution. This precisely controls stylus excursion from minimum to maximum groove amplitude.

And fourth, the QDC.1 electret transducer gives a perfectly linear signal from 5 Hz to 50 kHz, without phase shift.

dbx 117

Ever wondered why records seem to have less dynamic range than live performances? Commercial record producers typically have to sacrifice as much as 20db of dynamic range through compression.

The dbx 117 Decilinear Expander restores up to 20db of the dynamics missing from records, tapes and FM broadcasts. And, as a bonus, the surface noise apparent on even brand new records is almost completely eliminated. The model 117 also works as a noise reduction system so you make professionally noise-free, full-range recordings on any moderately priced reel to reel, cassette or cartridge recorder.

It can also be used for compression of audio signals, so useful for background music or voices in conference recording. The dbx 117 really is a must for any good quality component stereo system.

DISCWASHER

The dII fluid and brush are designed to have a precise working relationship as a fully integrated record cleaning system.

And while dII is chemically tailored to solubilize common dirt and debris on your records' surface, the dII formula was also developed to handle the newest problems of the record user—crystallized manufacturing lubricants.

Both components of the Discwasher system can stand on their own merit: an improved directional pile brush which lifts off rather than pushes around. And the dII fluid which is a chemically sophisticated product resulting from years of research.

But together, the relationship exceeds the expectations of the most critical audiophile. The dII relationship should be working for you.

Go on! Do something nice for your records. In return they'll do a lot more for you.
For brochure and list of stockists write to
Auriema (A'asia) Pty Ltd, 15 Orchard Rd, Brookvale NSW 2100. Phone 939 1900

11014C

Alpha HPE-777 Electret Headphones

There are now four different types of stereo headphone available to the hifi enthusiast: dynamic, electrostatic, electret and piezo-electric. Here is our first review of an electret headphone, the Alpha HPE-777.

A two-transformer adaptor is required to match the Alpha HPE-777 electret phones to audio amplifier outputs.

Although the phenomenon of the electret, the capacitor analog of a permanent magnet, has been known for over 50 years, it has only been in recent years that electret microphones have become widely available. And only within the last 12 months have electret headphones become available.

Electret headphones are claimed to have the advantages of electrostatic phones, i.e., good wideband and transient response plus lightweight construction, without the need for a polarising high voltage supply. They still require a couple of reasonably large transformers and a few ancillary components to match them to the low impedance output of audio amplifiers.

In practice, the need for a high voltage polarising supply with electrostatic headphones is of little consequence since the extra components add little in cost or bulk—running directly from the mains, the supply circuit consists of one or two rectifier diodes, a small filter capacitor and two high value resistors.

So there is really little to pick between electrostatic or electret headphones. They both have the potential for good performance but both require an adaptor containing transformers.

Very low weight is the immediately apparent feature of the Alpha HPE-777 headset. It has a weight of only 190g, not including coiled cord and plug. It has a comfortable, readily adjustable headband and the small, foam-filled ear-muffs sit over and on the ears rather than completely enclose them.

As a result, the Alpha headset is comfortable to wear for long periods and there is less tendency for the listener to suffer from hot ears.

Electret and electrostatic headphones cannot be connected to audio amplifiers or other equipment via the usual low impedance headphone jack. Instead, they are connected via an adaptor, as mentioned above. The adaptor for the Alpha headset is compact, with dimensions 106 x 63 x 150mm (W x H x D) and weight of 1.1kg.

The adaptor case gives an impression of flimsiness because of its plastic construction. It would be better if the case was made of steel because the transformers it houses are rather heavy.

A three-pin DIN socket is provided on the front panel of the adaptor and a slide switch to select the headphones or a pair of loudspeakers. On the rear panel is a set of screw terminals which accept spade lugs or bare wire for the connections from the amplifier and to the loudspeakers.

Insulated spring-loaded terminals would be preferable here because carelessly made connections to screw terminals can easily short the output of the amplifier.

Mounted on the rear of the slide switch, by way of the solder connections, is a small PC board which accommodates four resistors and the interconnecting wires. In the event of an open-circuit resistor or other fault, repairs to this PC board would be difficult, since there is no easy way of detaching the board from the switch, or the switch from the case. Admittedly, the need to make repairs is fairly remote.

Connected to an audio amplifier with a sine wave generator, the Alpha headphones give a remarkably smooth response over the whole audio band—from well below 40Hz to beyond the limit of audibility. In fact, it was our impression that these headphones gave the widest and smoothest frequency response of any we have yet heard.

If driven hard, there is a tendency for the phones to "frequency double" at below 100Hz, but this is typical of any headphone or loudspeaker with a small diaphragm. Even with this proviso, the bass is still very good. There is no suggestion that bass is lacking, as can be the case with some wideband phones.

On music, the Alpha headphones give excellent results. There is some tendency for surface noise on discs and tape hiss to be obvious, but the effect is not exaggerated to an unpleasant degree. At the same time, clicks and pops from discs do not seem to be emphasised to any great extent.

As with other headphones which radiate from the rear of the diaphragms, there is almost no isolation from outside noises but this is not usually a problem when listening in a quiet home environment. But if there are any other people in the room, they have to put up with an unpleasant "tinny" version of the music that the headphone listener is revelling in. That is the only real disadvantage.

After listening with conventional dynamic headphones, the Alpha units provide a listening revelation. At the suggested retail price of $59.50 which includes the adaptor, they are a bargain.

For further information on the Alpha HPE-777 headset and companion FB-1 adaptor, contact your nearest high-fidelity retailer. Trade enquiries should be directed to the Australian distributors, Ralmar Agencies Pty Ltd, 71-73 Chandos Street, St Leonards, NSW 2065. (L.D.S.)

One of four speaker arrays used to cover the 100,000 seat Los Angeles Coliseum.

How many speakers do you know could wipe out an entire football stadium?

Up to 80% of the good electrified bass performed in concerts and studios in the United States eminates from Cerwin-Vega speakers.

They are the same speakers that were used to create movie realism in the film "Earthquake". If Cerwin-Vega can produce brilliant sound at these "high distortion risk" levels, imagine how fine the quality will be on your stereo system.

And with Cerwin-Vega you never need a monster amplifier to get realistic sound levels. The 211R for instance is a classic example. An amplifier with as little as 5 watts RMS will drive these speakers at least 10 db louder than almost any others, yet these same speakers will take a full 100 watts RMS and produce a sound level of 116 db without distortion.

If Cerwin-Vega speakers can wipe out a stadium and simulate an earthquake, imagine what they could do in your home.

Model 211 (R)
Maximum Power Input:
100 watts RMS; 200 watts peak
Flat Frequency Range:
32-20,000 Hz ± 3½ db
Maximum Sound Levels:
116 db @ 4 ft. @ 100 watts
Dynamic Range:
76 db in a 40 db noise field
Crossover Frequency:
1500 Hz, 3000 Hz
Speaker Elements:
LF: 12 in., 18 Hz resonance, 2 in. voice coil, 13 lb magnet system, foam ½ roll annulus, 16,000 gauss, 1 in. p-p movement (L-123-W)
HF: 2½ in. dhorm, 1 in. phenolic diaphragm, 18,500 gauss (UHF-91)
MF: 1-(HF-91) Horn driver assembly
Configuration:
rectangular direct radiating with controllable upper mid reflection
Dimensions:
15½D x 15W x 26H

And unlike most manufacturers, every component that goes into a Cerwin-Vega speaker is made by Cerwin-Vega.

The advantages of doing this are obvious as we have complete control of the manufacturing process all the way. Everything from the voice coil to the oiled walnut finish of the speaker cabinets.

These newly introduced speakers were designed especially for people who want truly professional sound in their own home. You would be crazy to consider anything else before you hear them – and probably beyond redemption to consider anything else afterwards.

Distributed by Magnecord International Pty. Limited, 276 Castlereagh Street, Sydney. Tel. 61 9881.

Cerwin-Vega

PKB88513

Sinclair Project 80 FM Tuner & Decoder

Designed for the hi-fi enthusiast who is experimentally inclined, the Sinclair Project 80 FM tuner and stereo decoder modules are very compact and modest in cost. They are currently being marketed here, along with the rest of the Sinclair range, by Dick Smith Electronics

The Project 80 FM tuner module must be the smallest-ever FM tuner—it measures only 85 x 50 x 20mm. This gives it an immediate fascination value, at least for the technical person aware of its function, even though in some ways the miniaturisation has probably been taken too far. More about this in a moment.

Like the decoder and other modules in the Project 80 series, the tuner is fitted in a case of high-impact plastic, and is designed to be attached by rear screws to the front of a wooden case or turntable plinth. It can be fitted to a metal panel, but part of the metal must be removed (in the vicinity of the printed RF coils on the tuner PC board) to prevent detuning.

All of the tuner wiring is on the small PC board, with etched coils for both the aerial balun/transformer and the oscillator coil. The circuit is a fairly basic one, with signals fed to a two-transistor self-oscillating mixer, then through an aperiodic IF preamp transistor, and then through a ceramic IF filter to an IC limiter/detector. The latter appears to be of the quad detector type.

A dual varicap is used for tuning, one element tuning the aerial transformer and the other the oscillator. A dual slider pot varies the bias on the two varicaps, and hence beome the "slide-rule" tuning control. Its removable knob is made from clear plastic, and doubles as the dial pointer.

An interesting point is that the local oscillator operates at half the expected injection frequency, the mixer using its second harmonic rather than the fundamental.

AFC is provided, the control voltage for the varicaps being taken from the detector IC. The AFC may be disabled if desired using the small pushbutton.

The tuner as supplied will operate from 23-30V DC, drawing about 40mA. However it can easily be adapted for use with either higher or lower voltage supplies, if required. The lowest acceptable supply voltage is 11V, which requires the replacement of an internal zener and resistor, and possibly re-alignment of the varicap tracking.

The performance specs are fairly typical for a modest FM tuner design. Sensitivity is about 5uV for 30dB quieting, with 300mV RMS output for 75kHz deviation. Distortion is quoted at about 0.3%, for 75kHz deviation at 1kHz . The tuner will work into any amplifier or decoder with an input impedance of 10k or more, while the aerial transformer will match either 75 ohms unbalanced or 240-300 ohm balanced line.

On test, both in our lab and at the reviewer's home, the one bad feature of the unit which emerged is the tuning. Because of the rather poor mechanical link between the tuning knob/pointer and the pot slider, there is considerable backlash. This coupled with the critical nature of the pot's action (with 20MHz crammed into 40mm of travel!) makes it very difficult indeed to tune properly.

The makers are obviously aware of this, and in their manual they suggest that you rely on the AFC to pull in the stations properly. This is hardly the answer, of course, but happily there is likely to be only one or two stations on the FM band here for some time, so that it may not be too much of a problem.

In any case, there is another way out: Sinclair tell you in their guide manual how to disable the internal slider pot, and connect up external pots instead. They even show how to wire up the unit for push-button preset tuning, with or without a fine tuning control.

Once the tuner is actually tuned to the station, its performance is very good indeed. Fed with a reasonable signal (from 2MBS-FM in our case), it gave an output which was entirely satisfying when fed into a high-quality system—either in mono, or via the companion decoder.

For fixed-tuned operation, then, or as the basis for experimentation, the tuner certainly meets its design objectives.

The Stereo Decoder is designed not only for use with the companion tuner, but with any other suitable tuner or receiver. It is based on a single decoder IC, of the type requiring three associated tuned circuits. One of these is shorted out for mono operation, using a pushbutton.

Like the tuner the decoder is supplied ready to operate from 23-30V DC, but may be adapted for higher or lower voltages if desired.

The decoder is housed in a moulded case of black high impact plastic, which matches the tuner in styling. It measures a mere 47 x 50 x 20mm, and is again meant to screw to the front of a wooden panel or plinth.

The decoder chip has automatic stereo/mono switching, based on a pilot tone threshold, and operates a small LED indicator when a stereo signal is being received. It will normally switch to the stereo decoding mode when this occurs, unless the stereo defeat button is in the "down" position. This is to allow deliberate selection of mono mode when signals are too weak for good stereo reception.

Input impedance of the decoder is 20k, which should make it compatible with most detector circuits. Quoted separation is 30dB, and the intended load for each output is 22k or more.

The sample decoder pictured gave very impressive results when tested with the Project 80 tuner (which must have its de-emphasis capacitor disconnected for this). The outputs were crisp, and to the ear have an entirely adequate signal to noise ratio.

Looking at the output with instruments, the only qualification is that there is a residual 38kHz switching component — about 50mV P-P — in each output. This is fairly typical of simple decoders, and although it generally won't concern you for straight listening, it does mean that filtering will be required for tape recording. Otherwise you will get an annoying beat note, by interaction with the recorder's bias signal.

A simple circuit for a one-transistor active low-pass filter is given in the manual for this purpose. Two of these would be needed, one for each channel.

In short, then, the Project 80 stereo decoder is capable of excellent performance with the companion tuner, or any similar tuner or receiver. Its small size and flexibility should make it the logical choice for those who want to listen to the stereo transmissions with a minimum of effort, and at low cost.

Quoted prices for the Project 80 FM tuner and the stereo decoder are $34.50 and $21.00 respectively, including tax. The very useful Project 80 technical handbook (which gives circuits, suggested mods, troubleshooting hints, etc) is also available at a cost of $1.00.

Enquiries to Dick Smith Electronics Pty Ltd, 160-162 Pacific Highway, Gore Hill, NSW 2065.(J.R.)

News Highlights

Infra-red air defence system for US Navy

A new US Navy shipboard air defence system that for the first time integrates infra-red sensors with conventional radar and correlates the returns from both has been tested successfully by its designer, Hughes Aircraft Company's Ground Systems Group in Fullerton, California.

The system will be integrated with the NATO Seasparrow Surface Missile System to form the Improved Point Defence Surface Missile System. NATO nations that have Seasparrow include Denmark, Norway, Italy, Belgium and The Netherlands.

The combination of sensors will be used in an Improved Point Defence/Target Acquisition System (IPD/TAS) to speed the detection, identification and tracking of approaching targets.

George Cokas, systems division manager at the Fullerton facility, says this means that a single ship can quickly employ its own missile system to protect itself. Some ships now rely largely on umbrella-like fleet area defences, he said. IPD/TAS will provide the reaction speed needed for each ship to take action against threats that "pop up" over the horizon.

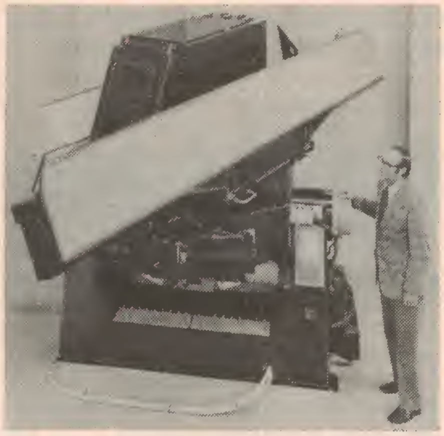
The successful integration of infra-red and radar is a result of research, development and testing under a $30 million, three year contract with the US Naval Ordnance Systems Command.

The complementary action of the two sensors will give the Navy exceptionally accurate target data that could not be achieved by one alone, said Leo Brajkovich, Hughes program manager.

Infra-red provides data on elevation and bearing, is immune to electronic jamming, and has the advantage of being a silent sensor — it cannot be detected and used by an enemy to locate and identify the point of origin.

The high-data-rate, wideband radar provides information on a target's range and closing speed. It is not affected by atmospheric disturbances, and employs the latest techniques for cancelling out "clutter", or undesired radar reflections. This enables detection of targets under the worst of natural sea or shore backgrounds, man-made clutter and electromagnetic interference.

Brajkovich said a further advantage of the system is that the two sensors, revolving every two seconds on the same pedestal, give an accurate correlation of target returns. A 75 degree angle of coverage in elevation permits the detection of very high or very low-flying targets, and a narrow angle in azimuth provides precise information on bearing.



Topside assembly of US Navy's IPD/TAS shows radar antenna at front, with infrared antenna set directly behind.

Five IPD/TAS systems are being developed. The first is an integrated system with infra-red and radar systems on the same pedestal supported by a computer, data displays and related equipment.

The modular design of the integrated system permits four single-sensor configurations. They include: automatic infra-red, automatic radar, manual infrared, and manual radar. The latter two do not include a computer and are equipped with different displays.

Because point defence systems must weigh the "value" of a ship against the cost of the system required to defend it, the "full-up" integrated model would probably be used for such high value ships as aircraft carriers, Brajkovich said.

The derivative systems, with lesser performance capability and lower costs, are available as options. These might be employed on ships to provide a level of self defence appropriate to their value and mission.

Brajkovich said land-based tests have been completed on all system configurations. Each developmental model will go through an objective evaluation in a stringent shipboard demonstration and testing program culminating in Navy OPEVAL (Operation Evaluation) in 1975 aboard the USS Downs, a destroyer escort.

—George E. Toles.

BRH recall order sparks controversy

. . . no reason for concern says Consumers Union

As reported in the March issue, the largest product recall in TV history was initiated in the US recently when the Bureau of Radiological Health (BRH) notified Panasonic that some 300,000 colour TV sets would have to be modified to prevent the possibility of excessive X-ray radiation.

The BRH order resulted from its finding that some Panasonic colour TV set models could be made to emit X-ray radiation in excess of the legal limit if a voltage hold down component failed. The order involves Panasonic in an estimated $9-15m modification program.

The wave of adverse publicity caught Panasonic off guard, prompting the company to initiate the recall program ahead of schedule. Panasonic, however, insists that the recall is unnecessary, and has commissioned an engineering study which it hopes will prove that the radiation-causing part failure won't occur outside the lab.

Subsequent reports tend to indicate that the BRH order is alarmist in nature, adding strength to Panasonic's original contention that there is no danger to consumers. This view recently received the backing of the powerful Consumers' Union in an Article published in February "Consumer Reports."

CU says it disabled the voltage hold down component in one of the Panasonic sets involved and found that "X-rays emitted from the front of the picture tube did indeed rise from an undetectable level to about 20 times the maximum legal limit." But, reports CU, due to the simulated failure the picture "became very bright, showed bright lines," and shrank—all "obvious signs of malfunction." The article concluded that consumers have no reason for concern.

3-inch rectifier handles 10MW

A 3-inch diameter silicon rectifier wafer—a third larger than any commercial rectifier wafer currently available—is being developed by Westinghouse Electric Corporation's Semiconductor Division.

According to Derrick J. Page, manager of semiconductor development at Westinghouse's Research Laboratories in Pittsburgh, the new rectifier will reduce systems costs and complexity while improving reliability. The new rectifier, says Page, can handle 10MW of power, double that of present commercial devices.

Basically, the device consists of a slice of silicon with a molybdenum backing plate separated by a thin layer of aluminium foil. Excellent heat dissipation is one of its important characteristics.

The prototype can handle 2,500V at an average current of 4,000A, and has withstood a surge of 26,000A under test. However, Page believes that the device could eventually handle 12MW and withstand surges of 40,000A.

Westinghouse expects to introduce the new rectifier as an off-the-shelf item next year. One of the first applications is likely to be in aluminium processing and fabrication, which demands high current. Other likely applications are in electrochemical plating equipment and in welding.

Optical communications for US Army

The US Army is examining the possibility of replacing twisted-pair cable in front-line communications with cable made of optical fibres. Over the next few years, in fact, the Army expects to make major procurements of the new lighter-weight and wider-bandwidth fibre-optic cables to replace its widely used 26-pair cable and the cable now used for pulse code modulation systems.

The Army first became seriously interested in fibre-optic communications last year, after Corning Glass Works, New York, had demonstrated glass fibres with attenuation at discrete near-infrared wavelengths of 20dB per kilometre. Corning was subsequently awarded an $80,000 contract to ruggedise the cable.

Optical fibre cable offers several major advantages over the Army's 26-pair cable. For example, fibre cable offers 100MHz of bandwidth compared with just 1kHz for 26-pair cable. Secondly, fibre cable is much smaller—0.125-inch in diameter, as against 0.625-inch diameter for 26 pair—and weighs only 30lb per 1,000 feet, while 26-pair weighs 200lb per 1,000 feet. Finally, the new cable offers much improved security, since the data can be digitised and multiplexed without making any physical changes to the material.

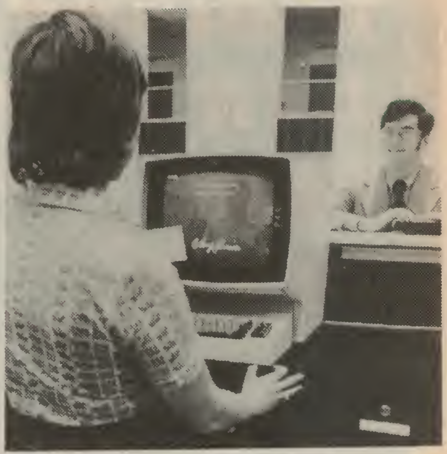
Computerised ID verification system

A computer-driven system that flashes a person's signature on a television-like screen is helping Emigrant Savings Bank protect its customers' accounts in New York City.

Emigrant is the first bank in the United States to use the IBM signature validation system. Linked to an IBM System/370 Model 145 computer, it is helping the savings bank to provide better customer service and greater security in such transactions as withdrawals and personal check cashing.

The new push-button verification system is of special benefit to depositors previously unable to cash checks or make withdrawals during late day or Saturday banking hours at branches where they are not personally known. The accessibility of central, computer-stored signatures and verification data enables these depositors to complete their transactions without delay.

In addition to the signature, personal information provided by the depositor upon opening his account may be used to further identify the depositor should a signature on a check or withdrawal appear to be unsatisfactory. This will



reduce the chance of accepting signatures forged from lost or stolen credit identification cards.

Each of Emigrant's 13 locations in the New York City area is equipped with IBM 3277 display consoles. To verify a signature, a teller enters the customer's account number on a keyboard and the signature of record is flashed on the screen for comparison.

—George E. Toles.

Low cost solar cells may soon be reality

Two new electronic devices which show promise as solar cells for converting the sun's energy into usable electricity were recently announced by Bell Telephone Laboratories.

One of the new cells has an efficiency of 12.5 percent in converting sunlight to electricity. This is comparable to the efficiency of silicon solar cells now used in such specialised applications as satellites and space vehicles.

The most common solar cells, invented at Bell Laboratories over 20 years ago, are made of extremely pure man-made crystals of silicon and have an efficiency of about 11 to 14 percent. However they are so expensive to make that they are used only in applications where cost is not a primary factor.

If it proves possible for the new Bell Laboratories' devices to be made using thin-film techniques similar to those used in making electronic integrated circuits, they should cost substantially less to manufacture than silicon solar cells.

The new devices can also be used as photodetectors, and in fact resulted from studies aimed at finding new photodetectors for converting light into electrical signals. As photodetectors, both devices are sensitive to infrared light and to part of the visible light spectrum. One device is more than twice as efficient as conventional silicon photodetectors at a wavelength of 1.06 microns. Low-loss glass fibres, which will be used in future optical communications systems, operate best near this wavelength.

Chefren's Pyramid foils SRI scientists

Featured in the January 1975 issue of "Electronics Australia" was an article detailing an electromagnetic sounding technique to be used by a Stanford Research Institute (SRI) team for investigations into Chefren's Pyramid, one of the three pyramids of Giza, Egypt.

Headed by SRI physicist Lambert Dolphin, the SRI research team planned to use the electromagnetic sounder to "see" through the walls of the pyramid, which scientists suspect may contain hidden chambers and passageways.

However, a recent report to hand indicates that the investigation has proved a failure. The SRI scientists found that the pyramid rock consisted of limestone of relatively high porosity and dampness. These factors rendered the technique useless by absorbing the electromagnetic signals.

The SRI team hopes to return next year with more equipment to carry on the investigation. A sonic equivalent of the electromagnetic sounder may be used on this next expedition, as this would not be inhibited by the water content of the pyramid stones. Dolphin is also eager to try out infra-red photography, resistivity, and other remote sensing techniques to look for pits around the pyramid that might contain "solar boats."

NEWS HIGHLIGHTS

New generation scientific calculator

The HP-21 scientific calculator, the first of a new generation of Hewlett-Packard pocket calculators, was introduced a few weeks ago. It is priced at $119.00 (sales tax exempt), and $133.28 (sales tax paid).

The HP-21 is the smallest and lowest priced model in HP's line. It is designed primarily for scientists, engineers and students. Scientific calculators like the HP-21 are also finding increasing use in marine and aircraft navigation, surveying, medicine and education.

The new HP-21 has all of the trigonometric and logarithmic functions of the HP-35. In addition, the user can calculate in either degrees or radians; convert from polar to rectangular coordinates and vice versa; format and round the display in either fixed or scientific notation; and perform register arithmetic with the contents of its single addressable memory.

The new calculator also has five fewer keys (30) than other HP pocket models. However, since several keys serve dual functions, the HP-21 is able to perform more functions and operations than the HP-35.

For further information contact Hewlett-Packard Australia Pty Ltd, 31-41 Joseph St, Blackburn, Victoria 3130.

British machine detects false signatures

A computerised system capable of detecting false signatures has been developed at the National Physical Laboratory (NPL), London, England. Designated "Verisign", the system was developed under funding provided by the Inter-bank Research Organisation and the National Research Development Corporation (NRDC) who hold the patent rights. As developed, the Verisign system is intended to restrict the access of unauthorised personnel to security sensitive areas.

There are two parts to the Verisign system. One, called Datapad, is a device for capturing the signature in such a way that its characteristics can be transmitted to a computer. It is a tiny desk with a roll of paper in it. Part of this paper is displayed in an opening and there the user writes his signature.

Underneath the paper are two electrically-conducting sheets spaced slightly apart. One conducting sheet has a voltage across it from left-to-right and the other from top-to-bottom. When the writer signs his name, these two sheets are momentarily connected at each point of stylus pressure. Two signals of voltage value are thus transmitted—one for the x-direction, the other for the y-direction. This data is transmitted at a rate of 50 times per second, providing a set of co-ordinates unique to each person's signature.

But these values by themselves are not enough. A forger with plenty of time could carefully imitate a signature to produce the same co-ordinates. The solution is to combine data from the co-ordinates produced with data on the time taken by the writer to move from one set of co-ordinates to the next. This time factor is a function of the writer's handshape, finger mobility, training and skill, and cannot be imitated.

The second part of the system is a computer into which is programmed the co-ordinates, velocities, accelerations etc of the writer's specimen signature. This data is compared to data derived from subsequent signatures for verification purposes.

Marconi to produce digital standards converter

A major improvement in satellite television transmissions between countries using different standards, and a greater world-wide exchange of television programs, will result from a British designed digital standards converter now going into commercial production.

The new converter, known as DICE (Digital Intercontinental Conversion Equipment), is the result of a three year research and development program undertaken by the Independent Broadcasting Authority (IBA). The sole manufacturing and marketing rights for DICE have been granted to the Marconi company.

DICE is capable of converting NTSC 525/60 colour pictures, as used in the United States and Japan, to 625/50 colour pictures encoded to PAL or SECAM (as required), and vice versa.

Computerised system simulates naval warfare

A US Navy destroyer's radar scope detects enemy aircraft zeroing in on a giant aircraft carrier at more than 1400 miles per hour. Subsonic cruise missiles are detected skimming the wave tops, closing in on the destroyer's midships. Aboard the destroyer, advanced electronic devices track the attackers and warning bells ring as the fire control officer orders defensive weapons launched.

But the enemy isn't finished. A sister destroyer reports a sonar contact on the port quarter, and the destroyers providing protective screening for the valuable carrier begin precision anti-submarine manoeuvres.

A nightmare situation? Yes, if the attack were true. But the attacking aircraft, the threatening cruise missiles, and the lurking submarine are only figments of the imagination of an attack simulation system being developed for the US Navy by the Hughes Aircraft Company under a $3.79 million contract.

The system, called Mister (a Mobile Integrated System, Trainer, Evaluator, and Recorder) will simulate, monitor and evaluate any number of attack situations.

Navy crews, aboard destroyers securely tied to friendly docks, will be able to learn to work as a team and to master their own equipment so that they will be prepared to react promptly and properly should an actual attack occur. In the meantime, no treasured fuel is expended and no expensive weapons are fired.

The Mister prototype—a mobile trailer packed with electronics, cables, and carry-on modules for connection to one or two ships—will be delivered to the Naval Sea Systems Command late in 1975.

"Mister will let the Navy prepare, execute, and score simulated fleet exercises over a 1,000-by-1,000 nautical mile area," said Joseph Garafalo, manager of Hughes' field service and support division that is developing the Mister.

"Combat team members will respond to complex situations on their own ships without having to deploy vessels or aircraft, or generate electro-magnetic radiation," he said. "This will result in more efficient crews and considerable savings in fuel and other operating costs."

Up to 128 moving targets can be simulated simultaneously by the system. Electronic warfare, landmass, and difficult weather and sea conditions will be controlled on the ship's indicators. Speed and correctness of crew responses to tactical situations will be evaluated by Mister's computer.

A single Mister van will be able to drill two ships at the same time, and it will eventually be possible to link to five Mister vans via telephone inter-connections for large scale integrated training.

—George E. Toles.

Privacy and Security: twin challenges to computer technology

How safe ARE computers from sabotage?

The rapidly increasing usage of computerised data storage and processing systems has served to generate increased concern on computer privacy and security safeguards. This concern not only includes the rights of the private individual, but also the safety of those institutions relying on computers to store and process ''sensitive'' information. Computer security must therefore be given increased emphasis if institutions are to be safeguarded from computer misuse and sabotage.

Mention the sophistication of computers and computer systems and their vast use these days and you're likely to open a Pandora's box. Out flies technology as a blessing—and a curse. Easily accessible information can facilitate business transactions and assist communications. It can serve a critical need by rapidly providing medical data. But on the negative side, the deep-rooted and irrational dread of mechanical "brain power" fuses with the real threat of unrestrained information gathering and dissemimation.

Dr Ruth Davis, head of the National Bureau of Standard's Institute for Computer Sciences and Technology (ICST), states the situation like this: "There is a societal problem today that signals a major confrontation between the individual in modern society and modern technology. It is the problem variously referred to as that of 'Invasion of Individual Privacy,' 'Data Security' or 'Computer Crime.' "

She sees several possible results from the impending conflict: It could ". . . trigger off negative chain reactions as well as possibly damaging restrictive controls on many applictions of technology." Or, if the various branches of Government and industry treat the problem lightly, ". . . then computer and communications technology could indeed victimise individuals and intrude upon their rights as citizens and consumers."

There are nearly 144,000 computers in the United States alone, either serving as isolated pockets of data, or incorporated into whole networks of information systems capable of instantly relaying data from coast to coast. Who controls the data gathering, who decides it's valid, who has access to it, how do we know it can't be tampered with?

The right of privacy is a legal matter. That right is not spelled out in the US Constitution, although privacy cases have been prosecuted under other rights. But states like California have already begun to act in favour of the individual by passing laws on privacy.

On a national level, the President's Committee on the Right of Privacy, chaired by former Vice President Gerald Ford, recently surveyed the situation and has put forward several recommendations.

Davis heads one of the Committee's 10 task forces; Robert Blanc, an ICST computer specialist, serves on another.

In addition, NBS has sponsored two conferences on privacy and computer security—one in November, 1973, and one in March 1974. These meetings brought together parties involved in the various aspects of the privacy/security question, including the legal and the technological. The purpose was to get an overall view of the entire spectrum of activities and to foster coordination at all levels.

Representatives from Government, the computer industries, consumer groups and academia attended and participated. Congressmen Barry Goldwater, Jr., (Calif.) and Edward I. Koch (N.Y.), both sponsoring separate legislation on privacy, presented their views at the March conference. Since that time, they have co-sponsored a bill that would define information practices to be followed with respect to personal data files maintained by Federal agencies.

Whether or not the rights are defined and listed, at least one facet of the technological problem must be confronted: computer security. Finding ways of protecting computers from physical damage or manipulation, and of protecting data and the access to it, require the aid of science and technology.

At present, how secure are computer

Reprinted from ''Dimensions'', by arrangement with the US National Bureau of Standards.

Two examples of computer crime

Already, several cases of computer crimes have been documented. Here are just two examples, both serving to illustrate the need for more stringent security precautions:

- A now classic and very imaginative example of computer crime was carried out by a young electrical engineer on the West Coast of the United States. Posing as a customer, he discovered a way to ''sign on'' to the computerised central supply division at the Pacific Telephone and Telegraph Company. Before someone betrayed him, he had illegally ordered over $1 million worth of equipment without paying for it.
- A weak spot in bank computing systems was found by a clerk in a Washington DC bank. Noting that the bank's computer only checked the magnetically coded deposit numbers on the bottom of incoming deposit slips, he replaced the usual supply of deposit slips on lobby desks with slips encoded with his own account number. Depositors using forms from the lobby desks thus unknowingly added money to his account. A few days later, he withdrew the money and disappeared.

The two examples listed here demonstrate the difficulties faced by companies in detecting illegal computer use. In the first example, the crime was detected only after an informant had come forward. In the second instance, the offence was not detected for several days, by which time the person involved had made good his escape.

systems? Clark Renninger, ICST's staff assistant for computer utilization programs, feels that a poll of experts would probably produce the consensus that, "No system on the market today is a secure system." Why? Because security has never before been a design priority.

That picture will probably be changing soon. One main misson of ICST is to provide automated data processing standards for use by the Federal Government. With its more than 7,000 computers, the US Government is the largest single computer user in the world. With Federal emphasis on privacy and security and with NBS coordinating with industry and consumers in developing secure systems and security standards, the results of their efforts will extend into both the public and private sectors.

A main drawback to the easy assimilation of security technology is a perennial hang-up—money! It's going to cost plenty. As an example, Davis has used a model of a hypothetical credit reporting agency. This agency, beginning with 1 million records containing 220 characters of data each, would have an average file growth of 10 percent per year—33 million additional characters annually. That's just to meet the requirements of pending security legislation, and it discounts growth of the agency. In 7 years the size of the file would double, software checking procedures would require implementation and processing time for each query would increase. Larger files would also mean more hardware. The cost rise would be significant.

Critics of computer security say that security at a high price is not necessary. They admit that at present the potential for unauthorised persons to gain access to files or to alter data is vast. But they cite statistics like those of a Stanford Research Institute study showing that documented transgressions are few.

On the other hand, computer crime is difficult to discover, and it's more difficult still to find the offender. Davis feels that costs could be spread among supplier industries, service industries, the consumer public and Government, thus easing the burden through sharing.

Davis also states, "Paying for privacy and security is not new to the American public. Some 15 percent of the 100 million telephones in the United States have unlisted phone numbers. The American public is currently paying $150 million for this right."

Threats to information systems range over a broad spectrum including events such as: natural catastrophe, sabotage, theft, bugging, accidental disclosure and physical assault. The countermeasure spectrum is just as extensive, for example: physical barriers and guards, passwords and identification badges, data encryption, audit trails, personnel practices, backup copies of data and access control software.

Not all threats will exist for each system, and not all countermeasures are appropriate to counter each threat. Each information system must be analysed to design an adequate security environment.

It is only when armed with this type of data and knowledge that an appropriate approach to the problems of data confidentiality and security can be formulated.

NBS is already taking action to make computer security a reality. By the fall of 1974, ICST intends to provide a set of guidelines for achieving physical security within Federal automated information systems. This should provide safeguards for computer equipment. NBS is also completing an initial survey of Federal practices in providing for computer security which will be published this year.

Safeguarding the system and the information itself is much more difficult. Supporting science and technology is not yet adequately developed for this purpose. But R&D is in motion both in Government and the private sector. NBS is attempting to determine whether operating system software can control access to data. Ways of foiling the biggest threat to computer security—human ingenuity—are being examined. Unique identification methods like voiceprints, memory passwords and fingerprints can reduce the number of people who can gain access. And such methods can better pin down the identity of those who have access to computer information so that the computer criminal cannot easily shield himself in anonymity.

Other problems persist. For example, one person may have a right to certain information stored in a computer, but not to all. It is necessary to restrict, as well as to prevent, access.

Data encryption can provide a safeguard in cases where unauthorised access does succeed. By translating information into mathematical systems (algorithms), decoding becomes difficult. ICST has wrestled with the challenge of developing these algorithms to the point that they provide a maximum level of security. NBS is in the process of making these simple algorithms generally available. Making the algorithms available, by the way, does not give away a secret. The system can be used to make unique codes.

Even with the efforts underway in Government and industry, Davis sees that, "The privacy problem has already introduced serious stresses between society and technology." She feels that perhaps the first step in solving the problem lies in the acceptance of responsibility by Government, the service industries and the courts. She says, "That first step is what we are striving for today."

Dr Ruth Davis, Director of the Institute for Computer Sciences and Technology (ICST), National Bureau of Standards.

WW III battles fought with computers

In addition to her views on computer security and privacy safeguards, Dr Davis holds further interesting viewpoints on computer technology. For example, she believes that the first battles of World War III have already been fought—using computers rather than cannons.

Discussing "Computers and the International Balance of Power" in an address to the Congress of the International Federation of Information Processing Societies at its recent meeting in Stockholm, Dr Davis said: "World War III is being fought with computer science. The first battles . . . may well have occurred when mathematical formulations of strategies and counter-strategies of realistic proportions were able to be tried out as war games on computers."

"With realistic wars being able to be fought in 20 minutes or 20 hours on computers, decisions to engage in such encounters have been nil. No statistical correlations are needed to validate the fact that no major encounters have occurred between large computer-processing nations," Dr Davis added.

Recognising the growing international importance of computers, Dr Davis pointed out that:

- Computer technology is a most effective technology for shifting balances of power and status quos without the catastrophic and dangerous effects characteristic of military technologies; and
- Those communities, power groups or nations using computer technology as an agent for change may be the most effective in achieving their objectives today and in the future.

Electromagnetic radiation in frequency measurements

...an elementary review

Perhaps one of man's most important discoveries is that of electromagnetic radiation, a discovery that has proved vital for a host of communications and measurement techniques. This article takes an elementary look at the nature of electromagnetic radiation and explains how it may be utilised for a range of frequency and measurement standards.

Light, according to Noah Webster, is the absence of darkness. Although Webster doesn't mention it, white light is actually made up of a spectrum of colours ranging from blue to red. And, of course, light can vary in intensity.

Light, the scientists tell us, is part of the same family of phenomena as electricity, radio and television waves, infrared heat, X-rays and some less commonly known rays like gamma and cosmic rays. That concept is hard to verify with the human senses, even though all electromagnetic waves taste, sound and smell the same — like nothing. Light we can see and electricity we can feel, as anyone who has ever stuck his finger in a turned-on light socket will testify. We can also feel heat produced by infrared, and use heat lamps on sore muscles, or bask in the sun — either of which feels different from electricity! The rest of the electromagnetic family is imperceptible to our sensory system.

All of this undoubtedly had something to do with man's being on earth for thousands of years before he got an accurate conception of the nature of electromagnetic waves.

In 600BC, Thales of Miletus (Greece) observed that amber, after being rubbed, attracted particles. That was the beginning of understanding electromagnetics. It wasn't until 2,255 years later that James Clerk Maxwell, a Scotsman, developed the theory of electromagnetic waves. He not only theorised that they existed, he developed equations which accurately described their behaviour. Thirty-one year later, in 1866, Heinrich Hertz of Germany demonstrated their existence experimentally.

Since then, scientists have proved indubitably (human sensory systems not withstanding) that light, radiated heat, radio, X-rays and some other things are basically the same thing — electromagnetic waves.

Though understood for only a little more than 100 years, the study of electromagnetic waves has contributed more to man's scientific understanding of his world and universe than has any other phenomenon. This is true largely because scientists can measure some electromagnetic waves more accurately than they can measure anything else. These measurements provide a basis for accurately measuring both time and distance, a relationship which becomes apparent upon examining the characteristics of electromagnetic waves.

Dr Donald McDonald, NBS physicist, tunes the output from a Josephson junction while watching for the best signal on an oscilloscope.

They all travel the same speed in vacuum, approximately 300,000,000 metres per second, or 186,000 miles per second. That's equal to about six laps around the earth in 1 second's time. Also, they travel in waves, with crests and troughs, like water. The distance from crest to crest (or trough to trough) is one wavelength.

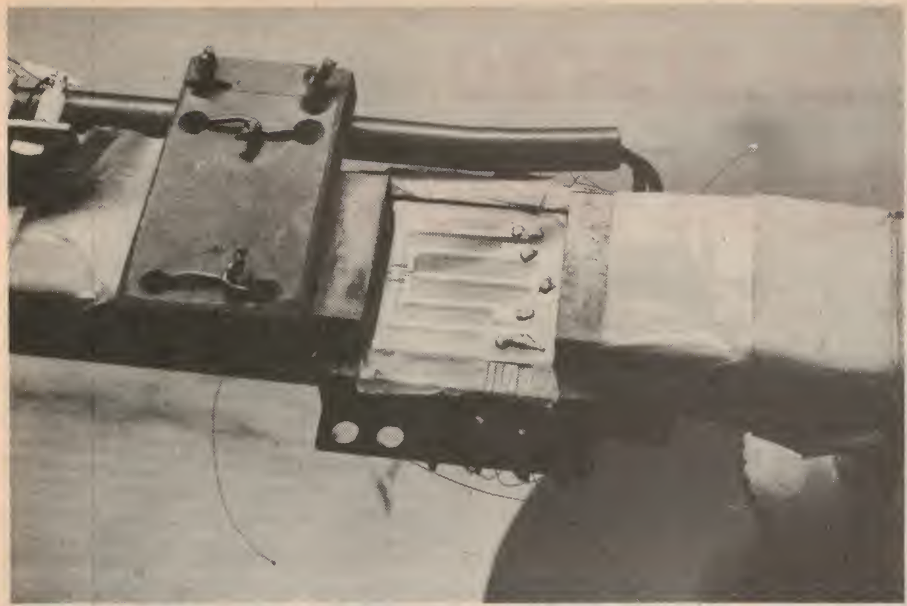
Accordingly, wavelengths are short or long depending on their frequency (the number of wavelengths generated in a given time period). For instance, household electric current is generated at the rate of 50 waves (cycles) per second so its wavelength is the distance it travels in a second, divided by the number of waves, or about 6,000,000 metres. Infrared is generated at several million million times per second and its wavelength is measured in millionths of a metre (micrometres).

Energy is required to generate electromagnetic waves of any frequency. The frequency of an electromagnetic wave is customarily expressed in cycles per second. To further simplify the language of electromagnetics, cycles per second are known as Hertz, in honour of Heinrich Hertz, mentioned earlier. Thus electric current has a frequency of 50 Hertz, and infrared about 3,800 billion Hertz or 3,800 Gigahertz (GHz).

The third dimension of an electromagnetic wave is its power, which is indicated by the height of the wave from crest to trough. Though this may be conceived as a physical dimension, it isn't usually measured as such. Instead, power is measured in terms of the heat it will produce, or an amount of work it will do.

Even a rudimentary understanding of frequency, wavelength and power of electromagnetic waves banishes much of the mystery about them. It explains why we can feel electricity, see light and feel the heat from infrared. It's because our sensory system responds only to certain frequencies. Similarly, a shortwave radio receiver cannot receive AM radio broadcasts, and vice versa.

At frequencies about 100 times higher than infrared, electromagnetic waves are visible as light — the absense of darkness. White lights simultaneously contains many or all of the frequencies which the human eye can see. Red light contains only the



Shown above is a Josephson tunnel junction mounted in a 10GHz microwave guide. At NBS, such junctions are used to maintain the US voltage standard.

lower frequencies of the visible spectrum; blue light the highest visible frequencies. Between red and blue are all the other colours of the rainbow with their respective wavelengths. Brightness indicates power and may range from invisible to intolerable to the eye.

Electromagnetic waves, whether light, electricity or radio, are most useful to man when their frequency (and hence wavelength) can be controlled. Such control requires accurate measurement of frequency, and measurement of high frequency is a continuing challenge to scientists at the National Bureau of Standards.

In November of 1972, Dr Kenneth M. Evenson and colleagues at the NBS Boulder Laboratories amazed the scientific world by accurately measuring the frequency of a helium-neon laser at 88,000GHz. A previously unachievable measurement, it required a battery of six lasers, some very temperamental electronics and several steps of harmonic frequency multiplication from the Bureau's primary frequency standard. It was a scientific breakthrough which led to the most accurate value ever measured for the speed of light.

High-frequency measurements depend on reference standards derived from harmonic multiplication of base standards of frequency. Electromagnetic waves interacting with matter can generate higher frequencies called "harmonics." By definition, the first harmonic is the fundamental frequency , the second harmonic is twice the frequency of the fundamental, the third is three times the frequency of the fundamental and so forth.

Thus, harmonics provide a method of generating higher frequencies in exact multiples of the fundamental. Since the harmonic's frequency is a precise multiple of the fundamental, it can be used as a standard for determining the frequency of an unknown electromagnetic wave of similar frequency. The unknown frequency need not be exactly the same. If it is approximately the same, the two frequencies when mixed together will produce a "beat" or third electromagnetic wave with a frequency exactly equal to the difference between the harmonic and the unknown. Accordingly, the unknown frequency is equal to the harmonic plus (or minus) the beat frequency.

Categorically speaking, the most desirable generator for measuring high frequencies is the one which produces the most harmonics. In the Evenson experiment, the 12th harmonic from a tungsten catwhisker-on-nickel diode was the highest useable reference frequency. This in turn was used to establish a new fundamental with the same frequency, which was then multiplied harmonically to establish a new fundamental, and then this "step" process was repeated.

Recently a group of NBS scientists, Ronald G. McDonald, Alan S. Risley, John D. Cupp, and a University of Colorado Electrical Engineer, J. Robert Ashley, developed a superconducting generator using a device called a Josephson Junction to do a similar kind of harmonic frequency generation but with fewer steps. The Josephson Junction is a device theoretically predicted by Englishman Brian Josephson in 1962, demonstrated in 1963 and responsible for one-half of the Nobel Prize for Physics going to Josephson in 1973. It operates at near absolute zero (-273 deg C or -460deg F) and produces many more harmonics than previous generators. As a result, McDonald's team has used, not the 12th, but the 401st harmonic as a reference frequency! With this reference, they were able to measure the frequency of an infrared laser.

In one step, using the Josephson Junction generator, they went from the fundamental frequency of 9.5GHz to 3,800GHz! To scientists trying to measure high-frequency electromagnetic waves, that's as exciting as a raise in pay. It is not only more efficient but potentially more accurate because of fewer steps.

To the non-scientist, it will make a difference too, but not this year. The system is still too esoteric to fit the needs of the everyday world of engineered electronic systems. Nevertheless, it does promise to simplify, eventually, many of our problems, especially those related to making lasers more useful — albeit by complicated electronics.

Swing over to stereo with this add-on decoder

Now that regular FM-stereo transmissions are in view or taking place in at least some capital cities, this little add-on decoder unit should have wide appeal. Providing your existing mono FM tuner or receiver is adequate, it will enable you to produce stereo signals of very good quality. The circuit uses one of the latest "no coils" decoder ICs, and includes active filters to inhibit heterodynes when tape recording.

If you're an audio hifi enthusiast with a mono FM tuner or receiver, you've probably been wondering if it would be possible to adapt it so that you can take advantage of the experimental stereo transmissions now being radiated. The answer to this is yes, provided that your tuner or receiver has a reasonable IF response, and provided also that you tackle the conversion in the right manner.

It isn't just a matter of simply wiring in one of the new decoder ICs, though—despite what you may have been led to believe. There are a number of pitfalls, and it is all too easy to fall into one of these and get very disappointing results. In this article we'll try to explain what the pitfalls are, and how to avoid them. So if you're keen to attempt the conversion, read on.

Before we proceed, however, a word of warning. It may not be possible to obtain good stereo signals from some low-cost FM portable receivers. This is because satisfactory stereo decoding can only take place if the "difference" signal components in the transmitted stereo multiplex signal are reproduced faithfully at the output of the receiver detector—particularly in terms of phase, relative to the 19kHz pilot tone.

While the IF response of a low-cost portable may be sufficient for quite good mono reception, its amplitude and phase response may be such that the difference signal components of a stereo signal become too distorted for satisfactory decoding. It is possible to correct for a modest amount of phase shifting using a correction network, as we will explain, but even this may not give acceptable results with some sets.

At this stage, neither we nor anyone with whom we have discussed the problem have had sufficient experience in converting receivers to be able to state the brands and models which are not worth tackling. We can't even tell you what proportion of sets may be in this category. All we can do is warn you that the possibility exists—and hope that you aren't unlucky enough to meet it.

Broadly speaking, just about any high quality FM tuner should be capable of being converted. The same should apply to the better quality portables. It is only the "bottom of the range" types which are likely to prove disappointing, although even there our experience suggests that some sets can give quite acceptable results when "tweaked".

To begin, then, let us look briefly at the transmitted stereo multiplex signal—for unless you understand how the signal is made up, it won't be easy for you to follow how it is decoded.

To make stereo signals compatible, or capable of being received by mono equipment (in mono), they are transmitted not as the original "left" (L) and "right" (R) signals, but as two composite signals. One of these composite signals is made by adding the L and R signals together and dividing by two, to produce a "sum" or "mono" (M) signal. This is used to directly frequency modulate the station's carrier, and it is this component—only—which is detected by a mono tuner or receiver.

The second composite signal transmitted is the "difference" or "stereo" (S) signal, formed by subtracting the R signal from the L signal, and again dividing by two. It is basically this signal which is used by stereo receiving equipment to separate out the two original signals.

To keep it distinguishable from the M signal, the S signal is shifted in frequency by using it to amplitude modulate a 38kHz supersonic subcarrier. Then, to prevent the subcarrier energy from restricting the actual signal energy which could be carried in the final transmission sidebands, the subcarrier itself is suppressed. This leaves the S signal in the form of a suppressed-carrier double-sideband components extending from 23 to 53kHz, and it is in this form that it is used to frequency modulate the station's carrier along with the M signal.

To allow the receiving end to make use of the S signal components centred on 38kHz, in the absence of the 38kHz subcarrier, a low-level "pilot tone" signal is also transmitted. This is a continuous tone of 19kHz, derived from the subcarrier oscillator and therefore phaselocked to it.

The final stereo multiplex signal thus normally consists of the M signal, the S signal components, and the 19kHz pilot tone. (It is possible to add a fourth signal

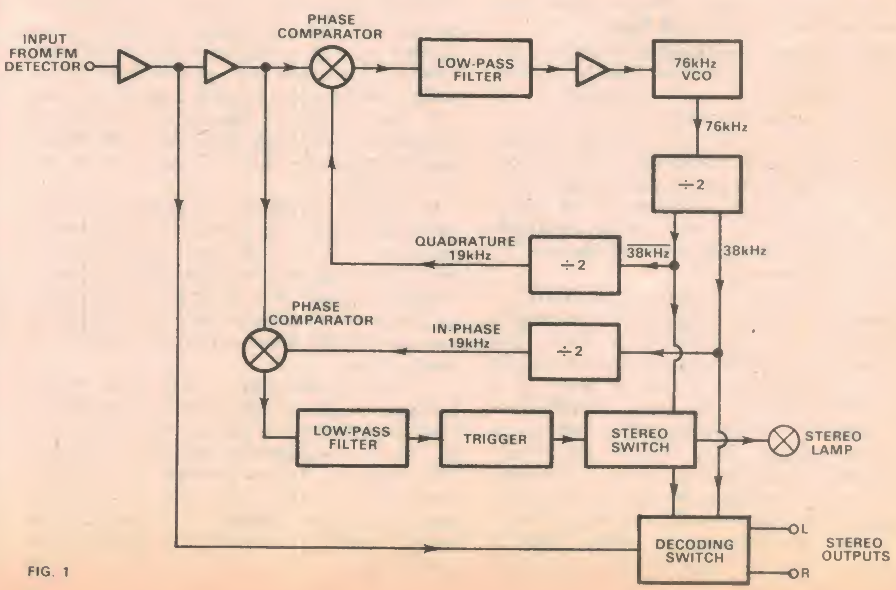


FIG. 1

Fig. 1: This is what's inside the XR-1310 IC, which forms the heart of the decoder. It performs virtually all of the multiplex decoding, automatically.

by JAMIESON ROWE
and DAVID EDWARDS

Built on a small PC board, the decoder is small enough to be mounted inside many tuners and receivers, if you wish.

known as the "SCA signal", for separate background music use, but this is not as yet being done in Australia.) It is this 3-in-one signal which is potentially available at the detector of a mono FM tuner or receiver, and necessary for proper stereo decoding.

Early FM stereo decoders operated in the following way. First, they used filters to separate the three signal components: a low-pass filter for the M signal (0-15kKhz), a sharp resonant filter on 19kHz for the pilot tone, and a 23-53kHz bandpass filter for the S signal components. Then the 19kHz pilot tone was used to regenerate the 38kHz subcarrier, and this was then fed with the S signal components into a synchronous demodulator, to recover the actual S signal.

The M (sum) and S (difference) signals were then fed through phase splitters into a resistive adding matrix, where they were combined to produce the original L and R stereo signals.

While this was a perfectly valid decoding technique, it had a number of practical drawbacks. Probably the main drawback was the filters required for separating out the three multiplex signal components; these tended to use fairly expensive L-C tuned circuits, and be critical of adjustment.

The drawbacks are avoided in modern decoders, including the design to be described here, by using an alternative decoding technique. The alternative technique is based on the fact that together, the M signal and the S signal components of the multiplex signal are equivalent to the main components of a signal produced by alternately sampling the original L and R stereo signals, each at a rate of 38kHz.

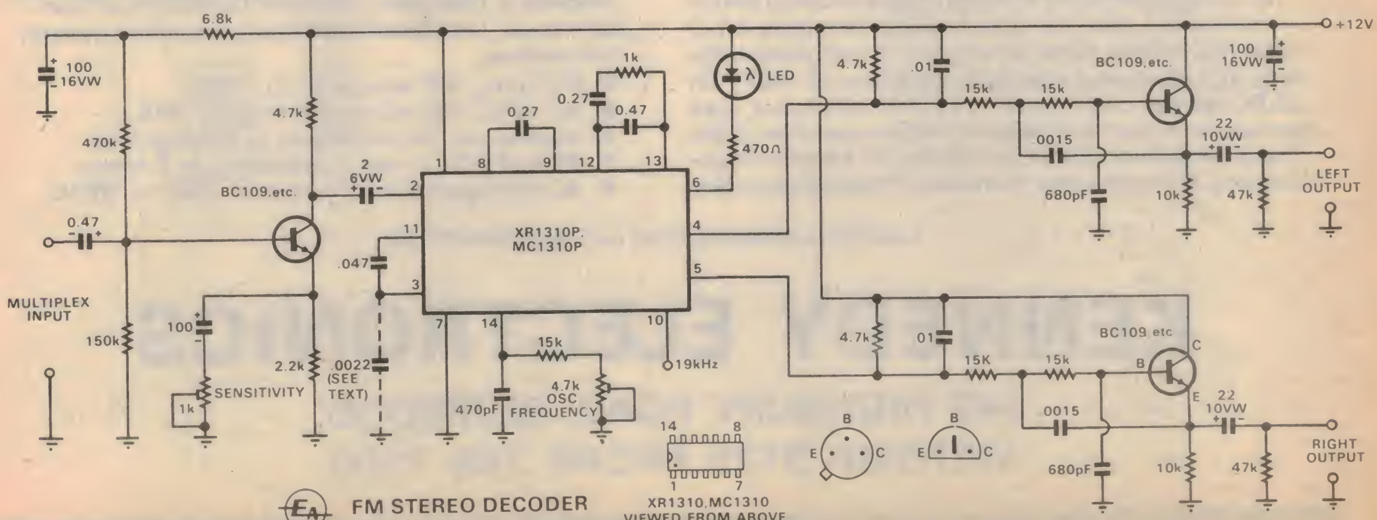
Because of this equivalence, it becomes possible to decode the original L and R signals in virtually a single operation, by performing a time demultiplexing operation. Thus in a modern decoder, the M and S signal components are not separated, but are left together. The 19kHz pilot tone is merely extracted, and used to regenerate the 38kHz subcarrier or sampling signal. This is then used to drive an electronic switching circuit, which alternately switches the composite M-plus-S signal between two output circuits. The bursts of signal arriving at the two output circuits are then simply filtered and de-emphasised, to produce the original L and R stereo signals.

At the heart of most modern decoders using this technique is a single IC, which performs virtually all of the operations just described. Not only this, but the IC usually performs automatic switching between stereo and mono modes, and drives a "stereo" indicator lamp into the bargain.

The particular IC used in our decoder design is the type XR-1310, made by Exar Integrated Systems of Sunnyvale, California, and distributed locally by A. J. Ferguson Pty Ltd. It is typical of the latest generation of these devices. Motorola make an equivalent device, the MC1310, which may also be used.

The XR-1310 uses a phase-locked loop (PLL) system to regenerate the 38kHz subcarrier. The PLL uses an R-C oscillator, whose natural frequency is set simply by

Below is the complete circuit for our decoder. Note the input preamp and the active filters at each output.



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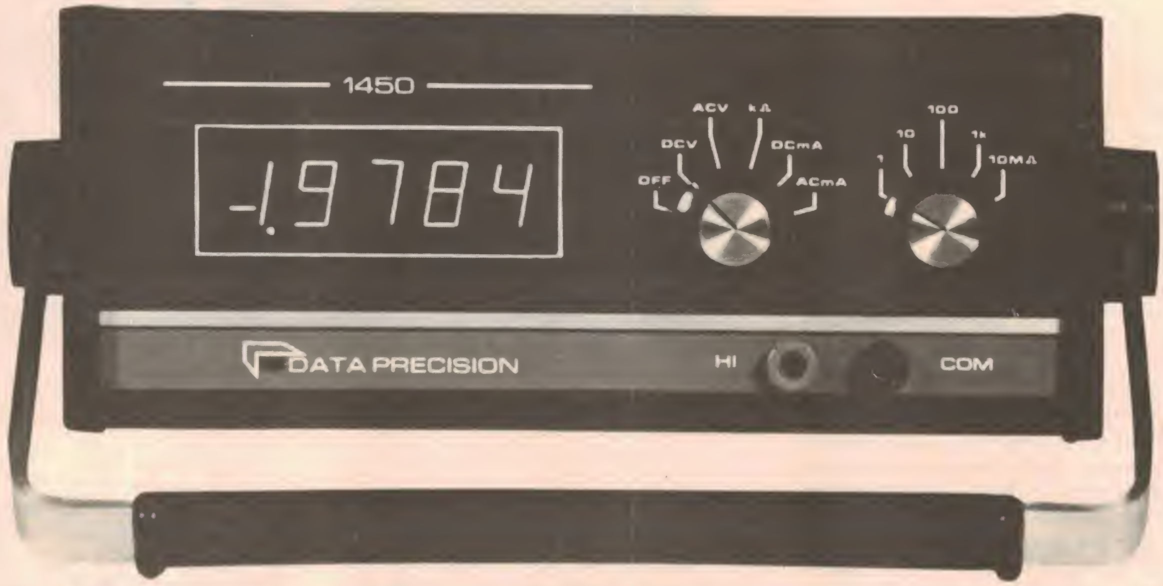

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means of a potentiometer. This becomes the only "tuning" control in the decoder, and it is easily set up correctly on signal.

For good channel separation, it is necessary for the decoder to switch the signal between the L and R outputs with an accurate 1:1 mark space ratio. This means that the regenerated 38kHz subcarrier should be an accurate square wave. For accurate phase locking it is also desirable that the 19kHz feedback component which is compared with the pilot tone in the PLL comparator should also be an accurate square wave.

To allow these requirements to be satisfied, the XR-1310 actually runs the PLL oscillator at 76kHz, twice the subcarrier frequency. This is then divided by two twice using flip-flops, to obtain accurate square waves at 38 and 19kHz.

Three flip-flops are used in all, one to produce the 38kHz subcarrier switching waveform, and two to produce two separate 19kHz signals. One of these is used in the PLL comparator, to lock the loop with the pilot tone; the other is used in a second comparator whose output is used for automatic mono-stereo switching.

Two different 19kHz components are needed because a PLL normally locks with its feedback signal shifted 90 degrees from the input signal. To make sure that the 38kHz switching signal derived from the PLL is in phase with the original subcarrier, it is therefore necessary to use a 19kHz feedback signal which is shifted 90 degrees in the opposite direction, so that the phase shifts cancel.

On the other hand the comparator used for mono-stereo switching must be fed with an in-phase 19kHz signal, because the comparator is used purely to indicate coincidence between the internal 19kHz signal and the incoming pilot tone. Hence the use of two divider flip-flops, to generate the 90-degree shifted and in-phase 19kHz signals.

A block diagram showing the various sections within the XR-1310, and the way they are interconnected, is shown in Fig. 1.

When mono signals are being received, there is no pilot tone present in the signal fed to the XR-1310, so that the PLL loop cannot lock; the 76kHz VCO accordingly free runs. As a result there will be no coincidence registered by the in-phase 19kHz comparator, and the stereo trigger and switching circuit will remain off.

In this situation a single 38kHz switching signal is fed to the decoding switch, and this causes the switch circuitry to feed the mono input signal to both L and R outputs continuously.

When a stereo signal is being received, the presence of the 19kHz pilot tone at the input of the PLL phase comparator causes an error signal to be produced, and the PLL acccordingly locks in. This causes the in-phase 19kHz signal to pull into phase coincidence with the pilot tone, so that the in-phase comparator produces an output to operate the trigger. And this in turn operates the stereo switch, turning on the stereo lamp and allowing a second (antiphase) 38kHz switching signal to be fed to the decoding switch.

The effect of the antiphase 38kHz switching signal is to cause the decoding switch to toggle the multiplex input signal alternately between the L and R outputs, performing the desired demultiplexing action. All that is necessary to recover the original stereo signals is de-emphasis and filtering.

Note that the existing de-emphasis network in the tuner or receiver feeding the decoder must be removed, because if retained it would seriously attenuate and distort both the pilot tone and the S-signal components. The stereo L and R signals are de-emphasised after decoding, using a time-constant of 50us for each.

Because of the switching action of the decoding circuit, the L and R outputs from the XR-1310 tend to have a significant 38kHz ripple component, even after de-emphasis, and despite internal rejection. While this generally causes no problems for direct listening, it can cause trouble when the signals are used for tape recording: a heterodyne tends to occur, due to interaction with the recorder bias oscillator. For this reason it is desirable for a decoder circuit to use additional filtering, to reduce the 38kHz ripple to a suitably low value.

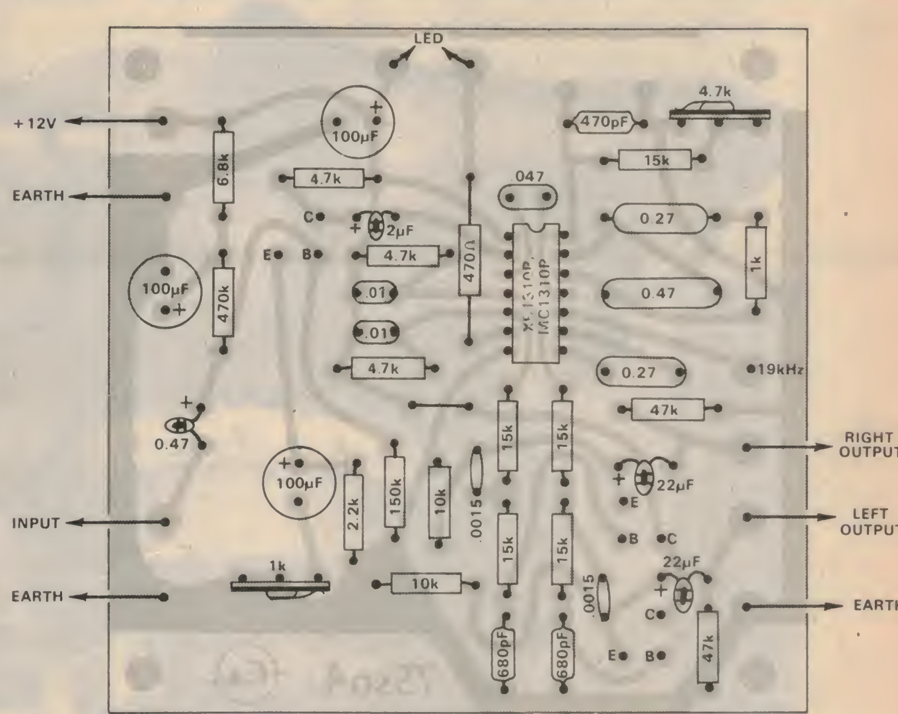
The decoder circuit which we have evolved using the XR-1310 does incorporate such filtering, along with a number of other features. These are visible in the main circuit diagram, where you can see that along with the XR-1310 device we have used three BC109 or similar low-noise NPN transistors, plus a handful of minor components.

One of the transistors is used as an adjustable-gain input preamp. This has been provided so that the decoder can be arranged to work correctly with a wide variety of tuners and receivers, including those whose detectors deliver only a low output. The preamp gain can be adjusted from a minimum of about 5 times to a maximum of about 100 times, and as the XR-1310 will operate with an input from about 200mV–2.5V peak to peak, this gives the decoder the ability to cope with detector output levels from about 2mV to 500mV P-P.

For tuners with a detector output greater than 500mV P-P, the gain of the preamp can be reduced to 2 times, merely by omitting the 100uF capacitor and 1k tab pot in the emitter circuit. And if the gain is still too great, the preamp can always be omitted altogether.

The components wired around the XR1310 are basically those recommended by the manufacturer. The R-C circuit connected to pin 14 is the VCO timing circuit, with the 5k pot for tuning. This is simply adjusted using an off-air stereo signal, as we will describe shortly.

The components connected between pins 12 and 13 form the PLL low-pass filter. Similarly the capacitor between pins 8 and 9, together with internal resistors, forms the low-pass filter for the



Wiring up the decoder should be straightforward if you used this diagram as a guide. It shows the board viewed from the component side.

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in-phase comparator. The capacitor from pin 3 to pin 11 couples the 19kHz pilot tone from the input preamp to the two phase comparators. Pin 10 is an output from the quadrature 19kHz divider, to allow monitoring.

Pin 6 is the collector of the stereo lamp driver stage, and as can be seen, the LED used for stereo indication is connected in series with a 470-ohm resistor between this pin and the positive supply rail. A 40mA or 100mA incandescent lamp bezel may be wired in place of the LED and resistor, if desired, but no more than 100mA may be drawn through pin 6.

Pins 4 and 5 are the L and R outputs of the decoder, respectively. The R-C circuits from each pin to the positive rail are the de-emphasis timeconstants. The values have been chosen to give very close to the 50us timeconstant specified in the Australian FM stereo standards.

Following the XR-1310 decoder circuitry are the two remaining transistors, wired as simple low-pass active filters. These are for suppression of the 38kHz switching components in the decoder output, to prevent heterodynes and similar troubles when tape recording. You can leave these stages out if you wish to save money and are certain that you will never want to record the decoder output signals, but they only involve a small component of the overall cost of the project. We therefore suggest that you wire them in, just in case.

Physically the decoder unit is built up on a small PC board, so that it can be either mounted inside your existing tuner or receiver, or alternatively housed in a small box of its own. The board measures 91mm square, and is coded 75sd4. We have reproduced the PC pattern actual size on these pages, for those who may wish to trace it, along with a diagram showing the position of all the components.

The main things to note when wiring up the PC board are that the IC, the transistors and the various polarised capacitors are correctly orientated. As you can see, there are not many components involved, and wiring the unit should be a simple job.

With the decoder wired up, you are ready to connect it up to the FM receiver or tuner, and get it going. The first thing to do is organise a suitable source of power supply. The decoder needs around 12V DC, fairly well filtered; its drain is around 40-45mA, when receiving stereo signals (i.e., with the LED "on").

If a suitable power source is available in the tuner or receiver, use this by all means. Otherwise, you may need to build up a simple power supply using a 12V stepdown transformer, a bridge rectifier using four EM401 or similar silicon diodes, and a 470uF/25VW electrolytic as the main reservoir. A 100-ohm 1W resistor should be connected in series with such a supply, for filtering.

An alternative approach would be to run the decoder from a 9V battery. This is quite in order, but the load resistors connected to pins 4 and 5 of the decoder IC will need to be reduced in value, from 4.7k to 2.7k. The shunt capacitors will also need to be changed, to preserve the de-emphasis timeconstants; increase them from .01uF to .022uF.

Having fixed up a source of power, the next thing to do is find the detector circuit of the tuner or receiver. The type of detector circuit employed will naturally vary, according to the vintage of the design; as a result, possibly the best plan is to work backwards from the audio output connector, in the case of a tuner, or from the volume control in the case of a portable receiver.

There are two things to be done, when you find the detector circuit. The first is to remove the original de-emphasis capacitor, so that the 19kHz pilot tone and 23-53kHz S-signal components become available for decoding.

Broadly speaking, you should find that there will be a series R—shunt C filter circuit between the FM detector output and the audio output jack or volume control. These will almost certainly be the de-emphasis components. Their actual values will vary, depending upon the impedance level, but their product in ohms times microfarads or kilohms times nanofarads will generally turn out to be around 75 (corresponding to a 75 microsecond timeconstant).

Having identified the two components, clip out the capacitor. It will generally not be necessary to interfere with the resistor, unless its value is sufficiently high to produce appreciable attenuation with the 100k input impedance of the decoder—or appreciable phase distortion of the S-signal components due to cable capacitance. If in doubt, short it out!

The other thing to be done at this stage is to arrange for signal take-off. In the case of a tuner, this may mean nothing more than making up a suitable cable to connect the decoder input to the output connector of the tuner. With a receiver such as a portable, you may have to add a suitable connector. The exact arrangement you make will no doubt depend upon whether you intend building the decoder into the tuner or receiver case, or having it as an outboard unit.

Similarly you will need to connect up the stereo outputs of the decoder to your amplifier system, using twin-shielded stereo cable and a suitable plug or plugs. Generally speaking, the signals are of an amplitude and impedance level suitable for a normal "radio" or "tape" input, on most amplifiers and control units.

At this stage you can turn on the power

(a) MONO OUTPUT (b) POOR SEPARATION (c) GOOD SEPARATION

FIG. 2

Fig. 2: Looking at the decoder outputs using an X-Y oscilloscope display allows you to check on the separation being obtained.

PARTS LIST FOR THE STEREO DECODER

1 PC board, 91mm square, code 75sd4
1 XR-1310 or MC-1310 stereo decoder IC
3 BC109 or similar low noise NPN transistors
1 LED, general purpose type
1 5k preset pot
1 1k preset pot
RESISTORS, ¼ watt 5%:
470 ohms, 1k, 2.2k, 3 x 4.7k, 6.8k, 2 x 10k, 5 x 15k, 2 x 47k, 150k, 470k.
CAPACITORS
1 470pF polystyrene
2 680pF polystyrene
2 1500pF polyester
2 .01uF LV greencap
1 .047uF LV greencap
2 0.27uF LV greencap
2 0.47uF LV greencap
1 2uF 6VW tantalum
2 22uF 6VW tantalum
1 100uF 6VW electro, single ended
2 100uF 16VW electro, single ended
MISCELLANEOUS
PC board stakes, mounting screws, connecting wire, solder, etc.
NOTE: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used, providing they are physically compatible. Components with lower ratings may also be used in some cases, providing the ratings are not exceeded.

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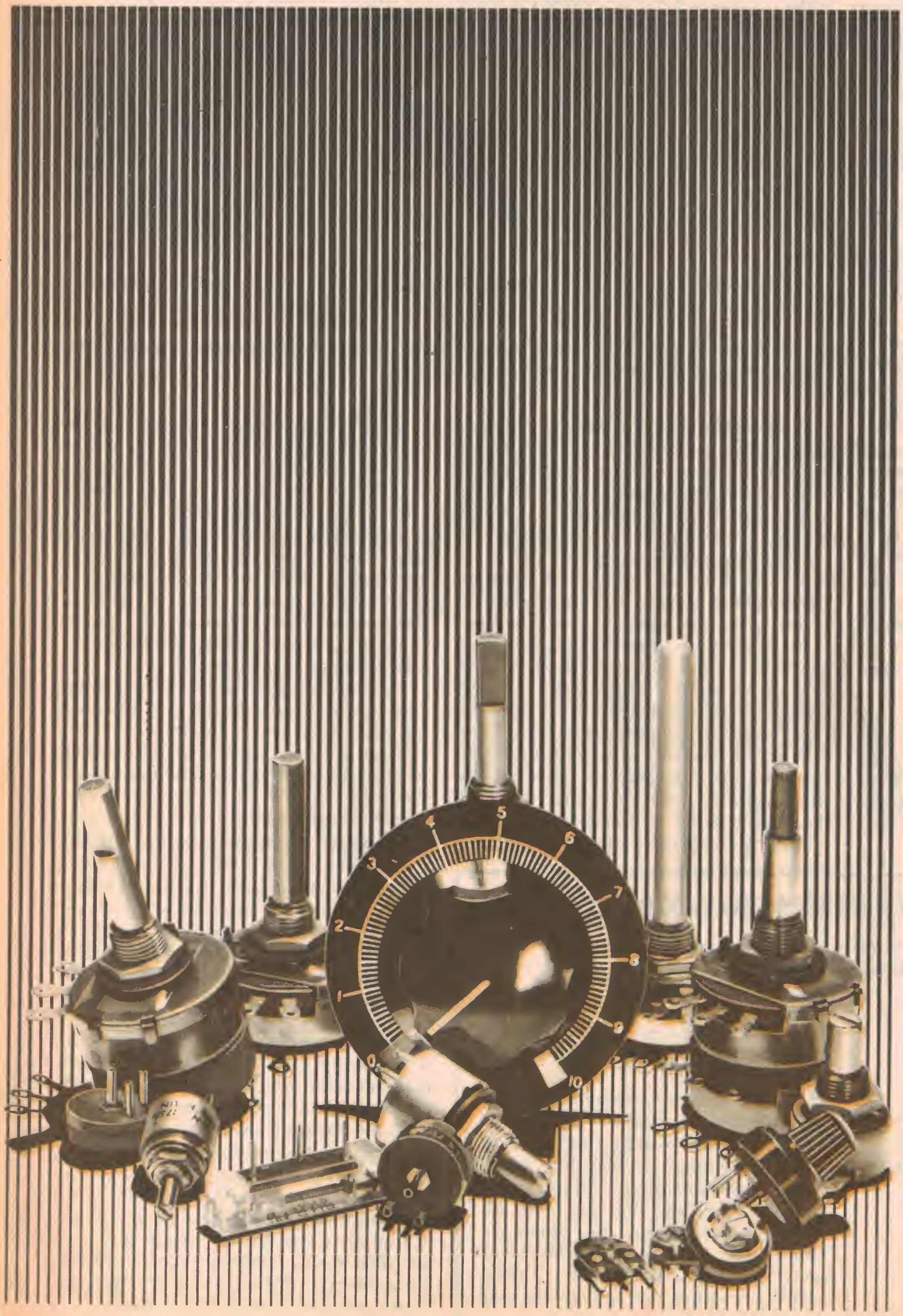

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to the various parts of the system, and tune the tuner or receiver to your local FM stereo station—we assume there is one, or you probably wouldn't have bothered!

Don't be surprised is the sounds coming out of the speakers seem to be mono, and if the stereo LED doesn't light. You still have the two preset pots to adjust, so that if the decoder bursts into full life immediately, this will be good luck more than anything.

If you have an idea of the output level coming from your tuner or receiver, set the preamp gain pot (the one near the input) to an appropriate position. If the output is fairly high, as from an IC quad detector, turn the pot to near the minimum setting (full resistance); if fairly low, as from a ratio detector, advance it to say ⅓ its resistance, as a starting point.

Now turn the VCO tuning pot to one extreme, and slowly turn it back towards the other extreme, watching the indicator LED. Note where the LED comes on, indicating that lock has been achieved. Then continue turning, and the LED should extinguish again before the pot reaches the far extreme. Then reverse the procedure, turning back slowly and again noting where the LED comes on.

The correct setting for the pot is midway between the two settings where it comes "on" in each direction.

With this pot set, the LED should remain on continuously, and you should be aware that the program from the loudspeakers is in stereo rather than mono. But more about this in a moment. Strictly you should now adjust the preamp gain more accurately, to the setting which will provide the best compromise between signal-to-noise ratio and distortion.

The idea is to adjust the preamp gain so that the decoder is handling the largest signal level possible, without running into significant distortion on signal peaks.

Probably the best way to do this is using the off-air signal from your local stereo station, waiting until it is broadcasting a typical loud passage. You can either use an electronic voltmeter to monitor the signal level at the input to the decoder IC (pin 2), setting it to about 2.5V P-P, or use an oscilloscope to monitor the L and R outputs of the decoder board and adjust the preamp gain until the signal is just short of the onset of peak distortion.

If you lack both an electronic voltmeter and an oscilloscope, the best idea would be to make the adjustment by ear. First turn up the pot until audible distortion is evident on signal peaks, then back it off until the distortion is no longer evident. This should be a good starting point, although you can modify it after further listening, if necessary.

If all is well, you should now be able to produce clean, well-separated stereo signals. But as we noted at the beginning of this article, this will depend very much on your mono tuner or receiver. If the IF response of this is not up to scratch, the results may be rather disappointing.

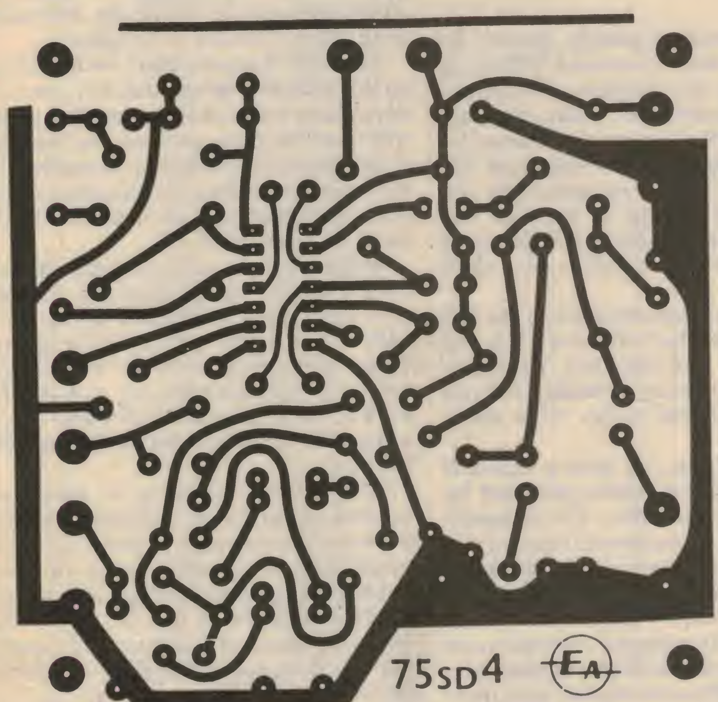
By the way, don't jump to the conclusion that all is well, simply because you were able to do the previous adjustments, and the decoder now lights up as it should whenever you are tuned to a stereo station. All this means is that the decoder is detecting the 19kHz pilot tone, is locking onto it, and attempting to decode the rest of the signal. If the signal reaching the decoder from the receiver or tuner is inadequate, you still won't be getting good stereo.

The best way to check if the system is really working well is to measure the actual channel separation being achieved, using an FM stereo signal generator. Failing this, though, another approach is to look at the two stereo outputs of the decoder using an X-Y presentation on an oscilloscope.

If you are able to do this, the pattern you get will give you a good idea of how well the system is working. You can interpret the pattern using Fig. 2 as a guide. If the signal is being very badly distorted by the receiver or tuner, you may get little more than the 45-degree mono signal line in (a). On the other hand if the system is working well, and there is good stereo separation, the pattern will tend to expand into a complex 2-dimensional pattern like that in (c). A modest amount of distortion will produce an intermediate pattern, rather like (b).

It is best to monitor the signals for a while with this technique, because you may be misled by the station broadcasting a mono record, or one with very poor separation to start with!

If you don't have access to either an FM stereo generator or an oscilloscope capable of X-Y display, probably your only course is to listen to the system for a reasonable period, and try switching the amplifier back and forth between mono and stereo modes, on different program material. This should gradually give you an idea of the degree of separation being achieved. Stereo headphones would be more suitable for this than loudspeakers, as they tend to make separation more apparent.



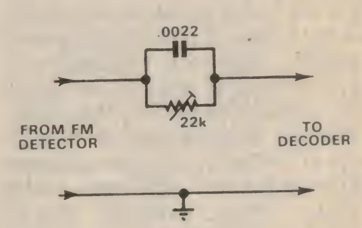


FIG. 3

Fig. 3 (above): A suggested phase correction circuit for poor receivers. At left is the PC pattern, actual size.

No doubt at this stage you're beginning to wonder if there is any way to improve performance, if the results so far are not the best. Yes, there are a couple of ways, and these will now be described. They may not be able to rescue the situation completely, if your tuner or receiver is producing too much signal distortion, but we have found that it is usually possible to effect a worthwhile improvement.

The first thing to do is look once again at the detector circuit of the FM tuner or receiver, and carefully seek out the IF filter capacitors. In equipment designed solely for mono reception, these

(Continued on page 115)

Frequency reference derived from VNG

If you are involved in making frequency or time measurements, this little unit should be of considerable interest. By phase locking a crystal oscillator to the 7.5MHz signal transmitted by VNG, it provides a source of reference frequency accurate to within a few parts in one hundred million.

by IAN POGSON

During the past fifty years or so, the accuracy with which frequency and time can be determined has progressed at a very rapid rate. In the 1920s, the US standards station WWV was transmitting standard frequencies with an accuracy of a few parts in a thousand. Today, the transmitted accuracy of the same source is of the order of a part in 10^{12}—an order of accuracy which is mind boggling. It is not our intention to come anywhere near this figure with the equipment which we we will be describing a little later, but at the same time you may find it surprising what can be achieved with simple gear.

The earliest frequency reference oscillators were simply well constructed self-excited types, with their obvious limitations. A major breakthrough came with the advent of the quartz crystal oscillator and improvements in techniques along these lines. Still another major breakthrough came with the masers and the caesium beam in particular, and this has become the basis for world frequency and time standards.

WWV derives its transmissions from a number of these caesium beam units, with the kind of accuracy already quoted. So far, we have only mentioned WWV, as it was among the pioneers of standard frequency transmissions. Today, there are dozens of standard frequency stations located in various centres throughout the world. Those stations of immediate interest are those located in the high frequency spectrum (3MHz to 30MHz), and they may be readily tuned in on a short wave receiver.

In addition to transmissions on the HF bands, there are other transmissions in the low frequency and very low frequency bands. These are not of immediate interest here, but it is hoped to say more about them later on.

Here in Australia, we have a standard frequency broadcast service provided by the Australian Post Office. The transmitters are located at Lyndhurst, Victoria and the frequencies used are, 4500kHz, 7500kHz and 12000kHz. These three frequencies are used at times such that a reasonably good coverage of Australia and New Zealand is obtained throughout each day. The 4500kHz transmission is on from 1945 to 0730, 7500kHz from 0845 to 0830, and 12000kHz from 0745 to 1930. All times are Australian Eastern Standard Time.

As well as providing standard frequency transmissions, VNG also transmits continuous time signals on each of the frequencies quoted. The transmitted accuracy of the standard frequencies, together with the time signals, is quoted as within one part in 10^{10} of the Australian Post Office standard of frequency.

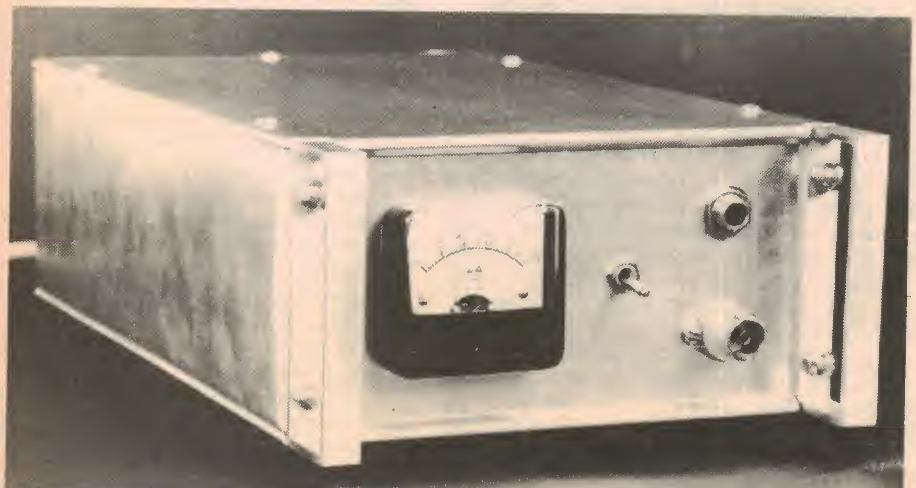
Although the transmitted frequency has an accuracy as just quoted, this does not necessarily mean that the received signal will have the same accuracy. In fact, due to propagation conditions prevailing for the high frequencies, the accuracy of the received signal may be degraded to the order of one part in 10^7.

Within the limits of these transmissions, there are many applications for this service, which may include surveying, navigation, frequency references, constant source of precision time, etc. The organisations and people who may find uses for these transmissions are many and varied and would include radio amateurs, hobbyists, etc.

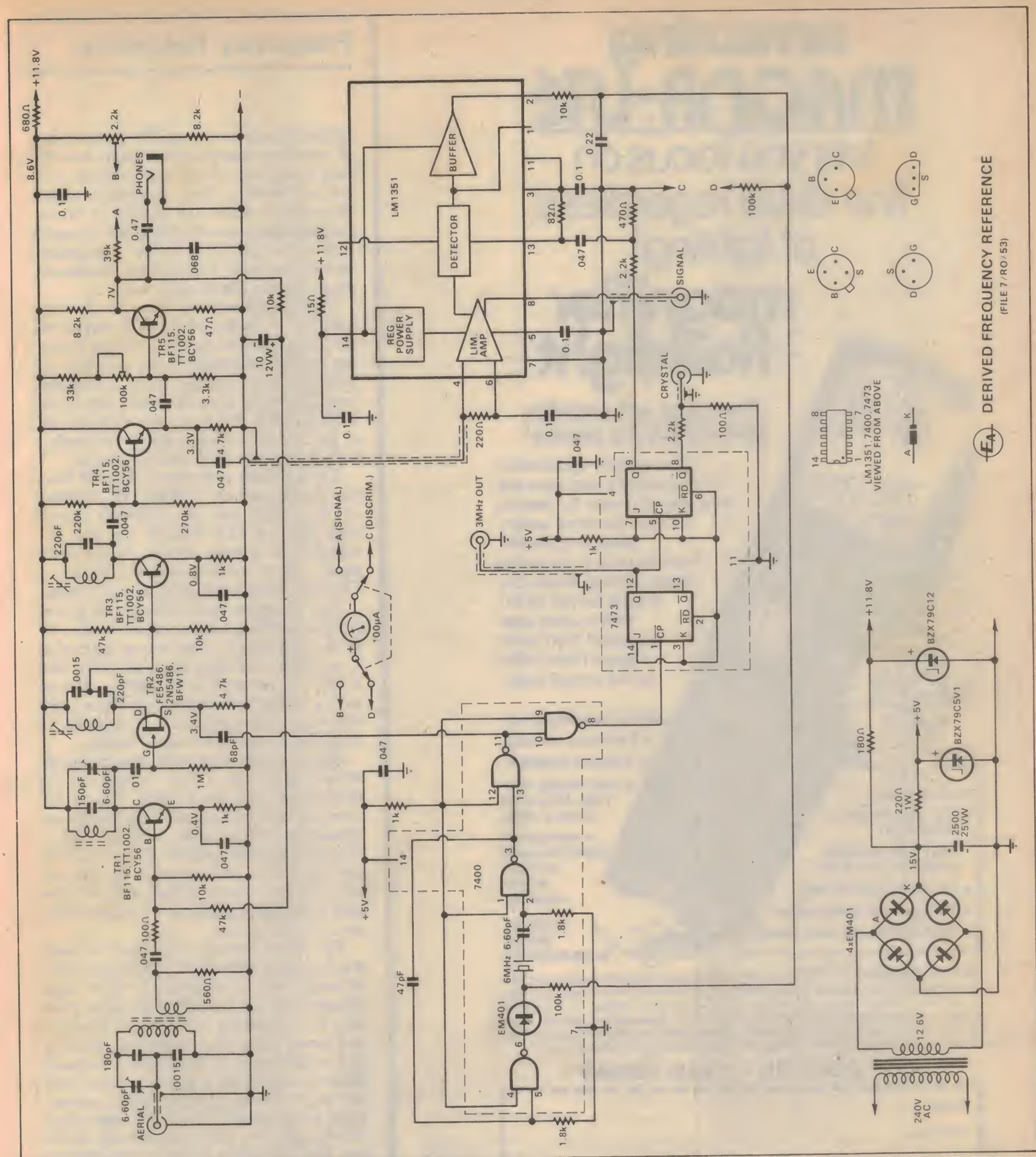
With all the foregoing in mind, we decided recently that a relatively simple receiver permanently tuned to VNG would be a very useful device. In order to keep the receiver as simple as possible, we decided to set it to one only of the three frequencies. Possibly the most useful one would be on 7500kHz, as it is on the air for almost 24 hours per day, and this frequency is the one which is most likely to have the greatest overall coverage.

Having decided on 7500kHz, just what form the overall design would take was the next big question. After a certain amount of juggling and consideration of various approaches, we came up with the arrangement which may be seen from the circuit diagram.

An RF stage, using a bipolar transistor with tuned base and collector, precedes a junction FET mixer with tuned drain on 1500kHz. The local oscillator feeding the mixer consists of a 6000kHz crystal oscillator incorporating a type 7400 quad 2-input NAND gate IC. One output from the crystal oscillator is directed to the mixer while a second output is directed to a type 7473 dual JK flip-flop, where the frequency is divided by 2, with the 3000kHz output terminated on the front panel. Another division by 2 gives a frequency of 1500kHz derived from the crys-



The completed prototype. The derived 3MHz output is terminated on the front panel.



DERIVED FREQUENCY REFERENCE
(FILE 7/RO/53)

tal, and this is ultimately compared with the 1500kHz derived from the incoming signal and crystal mix, as will be explained shortly.

The 1500kHz from the mixer is amplified in a further bipolar transistor stage with tuned collector. Output from this stage is then directed to an emitter follower, the output of which is split two ways. One output feeds a class B detector which makes audio available to a pair of phones, together with an AGC voltage which controls the gain of the RF amplifier. Voltage changes at the detector collector as a result of signal strength are also used to drive a signal strength meter in a switched bridge circuit.

The second output from the emitter follower feeds the IF input of a type LM1351 IC, consisting of a limiting amplifier, synchronous detector and buffer stages. The limiting amplifier strips the modulation from the signal, and passes it on to the detector. The 1500kHz signal derived from the crystal is fed into the detector also, and any change in DC level resulting from phase difference between the two 1500kHz signals is passed through the buffer stage and emerges at pin 2. This component is filtered by the 10k resistor and 0.22uF capacitor and is available to control the precise frequency of the 6000kHz crystal.

Although not referred to earlier, a diode variable capacitor is connected in series with the crystal and trimmer capacitor. The diode is reverse biased but this reverse bias will vary according to phase changes between the 1500kHz IF signal and the

Frequency Reference

1500kHz from the crystal. The capacitance of the diode changes accordingly and the loop brings the crystal back into the normal relationship. Thus, the precise crystal frequency is under the control of the incoming signal, provided that the incoming signal does not drop below a predetermined low level. Under these conditions, phase lock is temporarily lost.

The voltage established at pin 2 of the LM1351 IC under phase lock conditions can be monitored by the switched metering facility. Switched to this position, the meter reads the voltage across the control loop. Normally this will remain steady but if lock is lost due to a very weak signal, or for any other reason, the meter reading will change abruptly and noticeably.

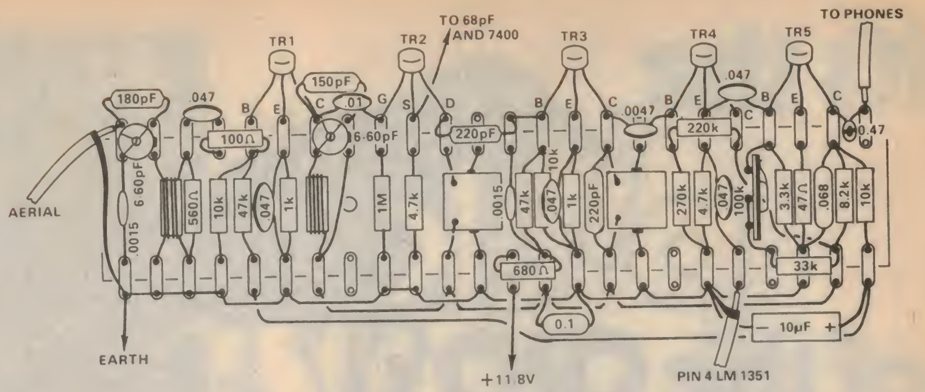
The 1500kHz component derived from the crystal, and the 1500kHz IF resultant of the signal and the 6000kHz crystal injection, are each brought out and terminated in a coax socket on the back panel. These outputs may be fed into a CRO for monitoring purposes if desired.

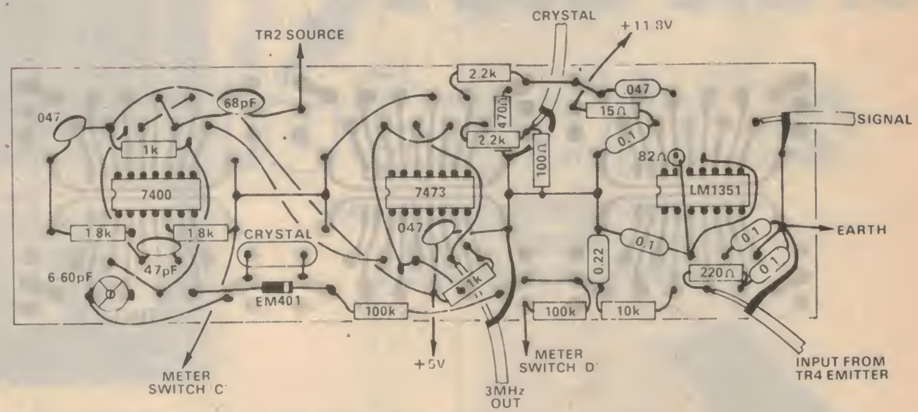
The complete unit derives its power from a relatively simple power supply. AC from a miniature power transformer with a secondary winding rated at 12.6V and 150mA is rectified in a bridge, filtered with a 2500uF electrolytic capacitor, split two ways and regulated to a nominal 12 volts and 5 volts with zener diodes.

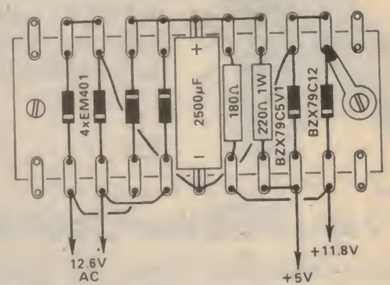
Before proceeding with constructional details, perhaps a few comments on components may be helpful. The prototype was built into a stock aluminium case measuring 155mm wide x 78mm high x 226mm deep and made by Horwood. This case proved to very suited to the job but layout is not overly critical and the unit may be housed equally well in some other case of your choice.

The power transformer which we used is a Ferguson type PF2851. We found that although this transformer is more than adequate for the job, its regulation is poor and the secondary AC voltage dropped to a lower value than expected, resulting in a modification in the initial calculated value of each of the resistors in series with the zener diodes. Readers who contemplate using another type of transformer should take this into account and make sure that the series resistors are adjusted if necessary, to avoid excessive zener diode power dissipation.

The crystal used in the prototype is a very old one mounted in a type FT243 holder. The original frequency was on 5975kHz and I etched it to 6000kHz. It seems to do the job adequately and if readers happen to have a suitable crystal available, then there seems to be no reason why it should not be used. On the other hand, suitable crystals in HC16/U or equivalent holders, are readily available to order from a number of manufacturers such as Hy-Q Electronics, etc.







These three wiring diagrams should make construction of the sub-assemblies a simple process. At top is the tuner board, whilst directly above is the composite wiring layout for the crystal oscillator, divider and detector stages. The wiring layout for the simple regulated power supply is shown at right.

In order to accommodate the three DIL ICs, we have made use of our printed DIP board (type 73d1). Although we could have originated a special printed board for the purpose, this would result in a more expensive component and so we have avoided this approach.

The metering toggle switch is one of the miniature types available in a number of brands. It may be noted however, that the circuit calls for a 2-pole switch and we have used a 4-pole unit. The reason is that we just happened to have a 4-pole switch available at the time.

The two 1500kHz IF coils are wound on Neosid type "E" assemblies and more will be said about these later on. The two signal frequency coils are wound on Neosid grade 900 slugs with a hexagonal bore. This method was used as it seemed to offer the best solution to a coil which is easy to make, low in cost and offering the extra advantage of self-shielding by virtue of the toroidal winding.

The bipolar transistors may be any high frequency type, such as BF115, TT1002, BCY56, etc. The FET mixer used in the prototype is type FE5485 and any similar type should be satisfactory. Power and zener diodes should present no problems but it will be noted that we used an EM401 as a varicap in the crystal oscillator. While some other makes of similar diodes may also be satisfactory, substitution should be considered with caution. Although we have not tried it, the Philips type BA102 should be quite satisfactory.

There are three ICs altogether in the unit and they are all readily available and low cost types. We chose the 14-pin DIL package but other packages may be used if the physical differences can be readily accommodated.

At the present time, it is not always easy to get the exact type of capacitor which may be specified and so it is often necessary to make substitutions. This can be done provided the function to be performed is not jeopardised by using an unsuitable type of capacitor. Generally, for bypasses and coupling, almost any type will do but where a tuned circuit is involved, or some other critical function, then care should be exercised in selecting a substitute. NPO ceramics may often be replaced with polystyrene types for preference and then a polycarbonate type may be used if this is the only alternative.

More specifically, the 2500uF electrolytic which we used, is rated at 35VW. This was used because we could not get the more obvious 25VW type at the time.

We used the newer solid dielectric Philips trimmers but if you have the old "beehive" type on hand, then by all means use them.

The complete unit is housed in an aluminium case and makes for a neat and compact assembly. Provided care is taken in detailed layout of the various parts, no trouble should be experienced with instability and so the sub-assemblies may be fitted to some other type of case which may be preferred. However, we will assume for the purpose of this discussion, that you will be fitting the Frequency Reference into the same case as that which we have used.

Although we imagine that this type of project is likely to be undertaken by those with some experience, some comments on construction may be helpful. The two coils associated with the RF stage are wound as toroids, using Neosid grade 900 slugs with a hexagonal bore. In each case, the tuned winding consists of 12 turns of 30 B & S enamel wire and the secondary of the aerial coil consists of two turns. A "turn" is established by the wire passing through the bore once. Terminations are not critical.

The 1500kHz IF coils are quite easy to wind. Even if you have not used the type "E" Neosid assemblies before, a short examination of the parts will soon reveal the method of assembly. The start and finish should be made to the pins most suited to the wiring layout. With the "E1" assembly, which is for frequencies between 50 and 2000kHz, each coil consists of 50 turns of 34 B & S enamel wire. If you happen to have an "E2" assembly, which is really for the next higher range of frequencies, you will find that you will have to wind on 70 turns. In either case, it may be necessary to modify slightly the number of turns on alignment.

The power supply board and the tuner board are each fairly straightforward but to assist the builder we have given wiring diagrams as a guide. Unless you have good reason to depart from the tuner diagram in particular, it would be wise to stay with it.

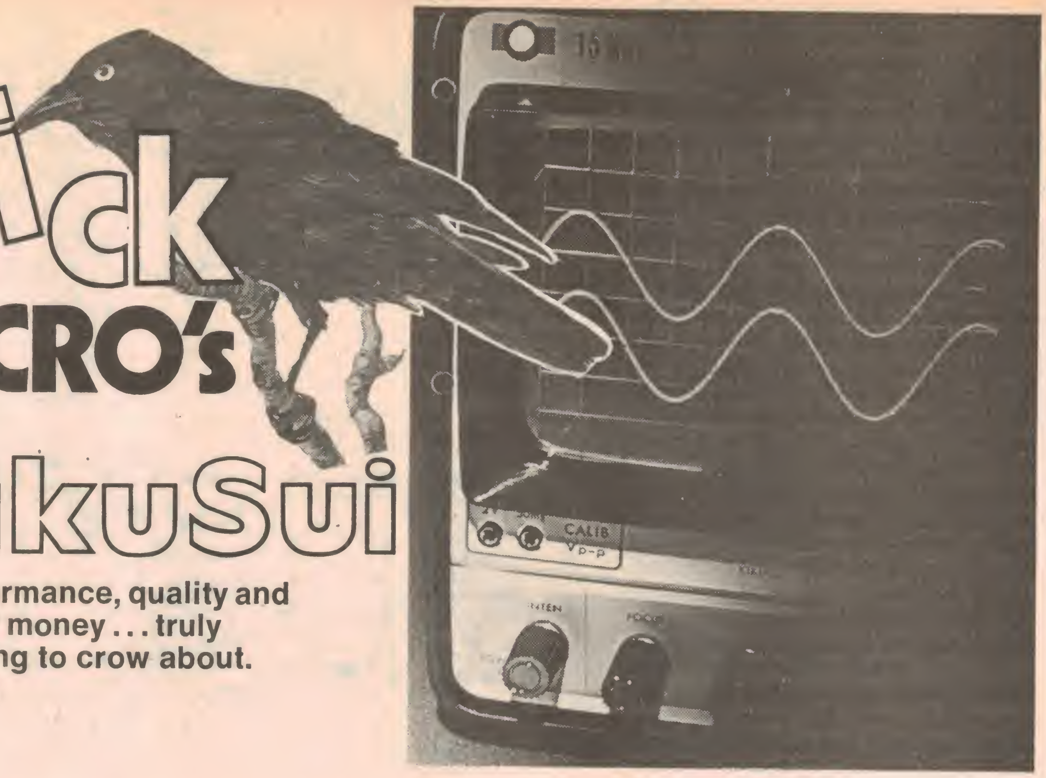
The three ICs and the associated components are mounted on one of our triple "DIP" printed boards. A composite diagram shows how we connected them up.

After completing all the sub-assemblies, it is a good idea to make preliminary tests and adjustments before mounting them into the case. Should any problems arise, it will be easier to gain access to the offending part.

To carry out tests and adjustments, you will need a multimeter, some means of approximate frequency measurements, a receiver, signal generator or even a counter. Although it is not essential, a double beam CRO will also be useful.

Having made the necessary intercon-

it's the pick of the CRO's



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3" 5 MHz 537 OSCILLOSCOPE

Vertical. Deflection Sensitivity: Better than 10mV/DIV. Bandwidth: DC (AC : 2 Hz) to 5 MHz. Input Impedance: 1MΩ parallel capacitance 36pF. Direct Deflection Terminal. Sensitivity: Better than 10Vp-p/DIV; 100 MHz (Response Frequency). **Horizontal.** Sweep Frequency: 10 Hz to 100 KHz and TV-H. Synchronization: Internal (+ & –), External. **External Horizontal.** Sensitivity: Better than 200mV/DIV. Bandwidth: 2 Hz-400 KHz. Input Impedance: 200KΩ parallel capacitance 25pF. Dimensions: 200W x 155H x 340Dmm. Net Weight: 4.5 kg approx. CRT: 3".

For the full details and a demonstration contact:

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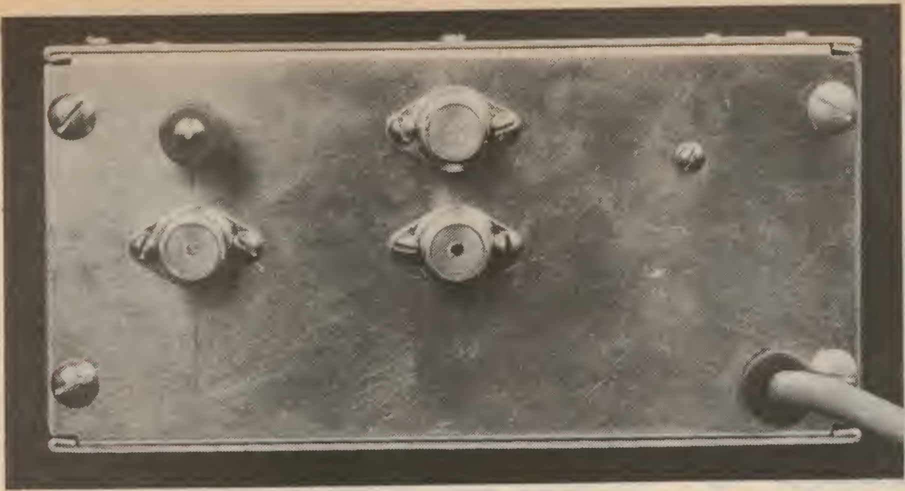

A rear view of the prototype. The two aerial sockets are on the left, while the 1500kHz component derived from the crystal, and the 1500kHz IF resultant of the signal and the 6000kHz crystal injection, are terminated on the right.

nections, the first check may be a general measurement of voltages, against those given on the circuit. Assuming that all is well, check that the crystal is oscillating and giving a signal on 6000kHz. This may be done with a suitably calibrated receiver, CRO, or a frequency counter. To check that the first divider is working, check its output for 3000kHz and then the second divider by checking its output for 1500kHz. With the meter switched to signal strength and with no aerial connected, adjust the 2.2k trimpot for meter zero reading.

With these parts functioning, we are now in a position to adjust the tuner. Remove the crystal from its socket and feed in 1500kHz from a generator into the gate of the mixer. Adjust the slugs in the two IF coils for maximum reading on the signal strength meter. Replace the crystal and feed 7500kHz from the signal generator into the aerial terminal and adjust the trimmers on the aerial and RF coils for maximum response on the meter.

Remove the generator and replace it with a suitable aerial. Under normal conditions, VNG should now be received. Plug a pair of headphones into the jack and adjust the bias on the class-B detector for best recovered audio. Now go over each of the two IF coil slugs and the aerial and RF coil trimmers and carefully adjust them on the signal for maximum response in each case.

Unless your crystal is very close to frequency and already locked in, by now you will be hearing a beat note in the headphones, which is the difference between the 1500kHz from the crystal and the 1500kHz derived from the crystal and the signal.

If you are fortunate enough to have a counter or other means of determining the crystal frequency very accurately, then the crystal should be adjusted as closely as possible, by means of the trimmer and with the aerial disconnected. Having done this, no further adjustment should be necessary as far as the crystal is concerned. If you have a beat note in the headphones, as referred to a moment ago, then the trimmer should be adjusted to bring the crystal into lock. The crystal will stay in lock over quite a wide range of adjustment but the situation should be aimed for where the crystal is as close as possible to the nominal frequency, with no input signal. This may be arrived at approximately, without special instruments, by making use of the meter readings when it is switched to measure the loop voltage. There should be very little change in reading as shown under signal conditions and when the aerial is removed.

LIST OF COMPONENT PARTS FOR THE FREQUENCY REFERENCE

1 Case, 155mm wide x 78mm high x 226mm deep (Horwood)
4 Rubber feet for case
1 Rubber grommet for mains cord
1 Meter, 100uA FSD, 45mm x 42mm
1 Miniature toggle switch, DPDT
1 Phone jack socket, 6.5mm
4 Coax sockets (Belling & Lee, McMurdo)
1 Aerial terminal
1 Power transformer, prim 240V, sec 12.6V 150mA (PF2851 or similar)
1 Crystal, 6000kHz, ambient temp, adj tol .01 per cent, 32pF input cap, HC6/U suggested holder
1 Socket for crystal
1 Printed Dip board, 3 sections (73d1)
1 Miniature tag board, 24 prs tags
1 Miniature tag board, 11 prs tags
1 Miniature tag strip, 7 tags with 2 mounting lugs
2 Neosid type E1 coil former assemblies (see text)
2 Neosid grade 900 slugs with hex bore
6 Brass spacers, ¼in dia x ¼in long with clearance hole
1 3-way terminal strip
5 Diodes, EM401 or equivalent
1 Zener diode, BZX79/C5V1
1 Zener diode, BZX79/C12
4 Transistors, BF115, TT1002 BCY56, or similar
1 Transistor, FE5486, 2N5486, BFW11
1 IC, LM1351 14-pin DIL
1 IC, 7400 14-pin DIL
1 IC, 7473 14-pin DIL
3 14-pin DIL sockets

RESISTORS (¼W or ½W unless stated otherwise)

1 15 ohms	1 2.2k trimpot
1 47 ohms	1 3.3k
1 82 ohms	2 4.7k
2 100 ohms	2 8.2k
1 180 ohms ½W	4 10k
1 220 ohms	1 33k
1 220 ohms 1W	1 39k
1 470 ohms	2 47k
1 560 ohms	2 100k
1 680 ohms	1 100k trimpot
4 1k	1 220k
2 1.8k	1 270k
2 2.2k	1 1M

CAPACITORS

1 47pF NPO ceramic
3 6-60pF Philips trimmers
1 68pF 630V polystyrene
1 150pF 630V polystyrene
1 180pF 630V polystyrene
2 220pF 630V polystyrene
2 .0015uF 100V polycarbonate
1 .0047uF 25V ceramic, or polycarbonate
1 .01uF 25V ceramic, or polycarbonate
8 .047uF 63V ceramic, or polycarbonate
1 .068uF 100V polycarbonate, or ceramic
4 0.1uF 100V polycarbonate, or ceramic
1 0.22uF 100V polycarbonate, or ceramic
1 0.47uF 35V tantalum, or polycarbonate
1 10uF 12VW electrolytic
1 2500uF 35VW electrolytic

MISCELLANEOUS

3-core flex with 3-pin plug and flex clamp, screws, nuts, hookup wire, solder, solder lugs.

Note: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used, providing they are physically compatible. Components with lower ratings may also be used in some cases if available, providing ratings are not exceeded.

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EAR

At this point, the unit is functioning substantially as in its finished form. It may now be fitted into the metal cabinet. The pictures show the disposition of the major components and sub-assemblies. The tag board which includes the tuner, is mounted on the right hand side of the box, looking from the front panel and with the RF stage nearest the front. The printed board assembly is mounted the other side of the box, with the crystal oscillator nearest the front. Both boards are mounted with ⅛in Whitworth screws and nuts, with ¼in brass spacers between the board and the bottom of the box.

The power supply, which includes the transformer and wiring board, are located at the back of the box. The mains lead is brought in through a rubber grommet, clamped and terminated on a three terminal strip. The remaining items are the coax sockets and aerial terminal on the back panel with the meter, sockets and switch on the front panel. With all these items fixed, we are ready to finish off with the interwiring.

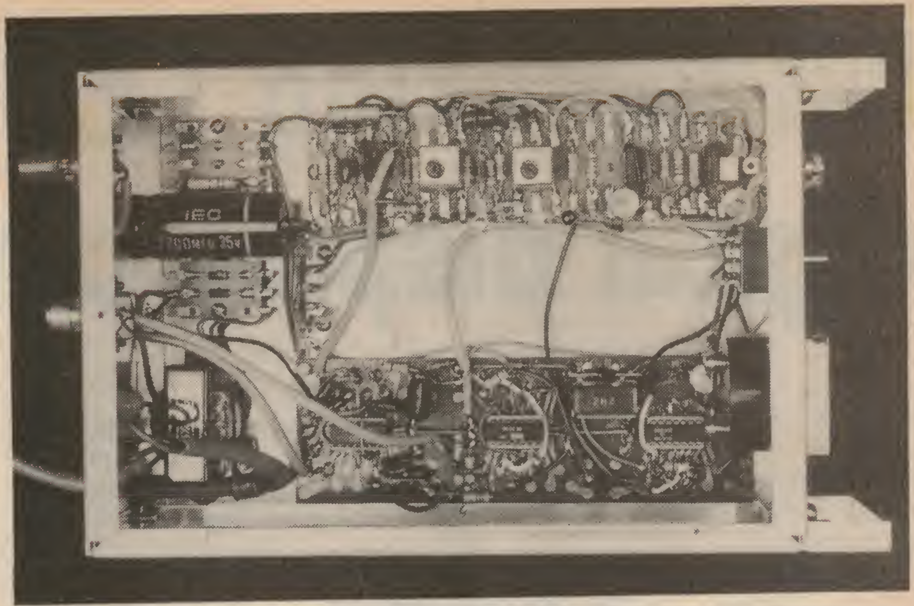
Where signals are involved, we used light coax cable. These leads include that from the aerial terminal, the 3MHz component from the divider to the front panel, and the 1500kHz components from the emitter follower to pin 4 of the LM1351 and the two to the coax sockets on the back panel. We earthed the braid on each lead at both ends.

With the unit completely installed in its cabinet, it would be wise to go over all adjustments and give each a final touch. The instrument is now ready for service.

An essential ancillary for the successful operation of the Frequency Reference is a good aerial system. Without pursuing the subject very far, suffice to say that this item should be given due consideration, particularly in noisy areas and where the maximum service time is required.

Already we have mentioned that 3MHz has been made available at the outlet socket on the front panel. This frequency may be multiplied, divided and processed to suit the needs of the individual. As well as 3MHz, there are two sources of 1500kHz brought out to sockets on the back panel. The main idea of making these facilities available is to put both waveforms up on a CRO to check on their phase relationship, etc. If 1500kHz is required for standard reference purposes, it would be better to use that component derived from the crystal, as the one from the IF of the receiver may have a certain amount of noise with it.

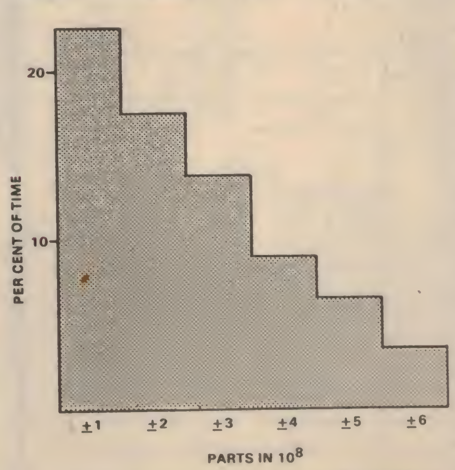
At the beginning of this article, I mentioned something of the order of accuracy of the signals transmitted from VNG. So far, no mention has been made of the accuracy of the received signal. Fortunately, I was able to gain access to some very sophisticated equipment and have some measurements made. The measurements were undertaken in a location which was not particularly favourable as far as reception of VNG is concerned. The aerial system could be described as sufficient, but not at all optimum for the purpose. Noise was somewhat of a problem but this did not seem to affect results while the signal was reasonably strong.



This view shows the completed prototype with all the modules in place. Follow this photograph in conjunction with the wiring diagrams.

The 3MHz output of our Frequency Reference unit was connected to a counter with a readout accuracy of one part in 10^9. The timebase of the counter is referred to a Caesium beam, with a considerably higher order of accuracy again. Several series of readings were taken, extending over 24 hours and the results were every bit as good as I had hoped and better than I expected. To sum up briefly, the readings taken for most of the time were within a few parts in 10^8.

Reference to the abbreviated graph will give quite a good idea of the general performance and the accuracy which can reasonably be expected. The graph shows what percentage of the time the order of accuracy was found to lie within the stated limits on a representative set of measurements. A reading of plus or minus one part in one hundred million occurred 22½ per cent of the time. Then a reading of plus or minus two parts occurred a further 17.4 per cent of the time, etc. Checking further, it may be seen that the accuracy is within plus and minus five parts in one hundred million for 69.2 per cent of the time. This is represented by the area enclosed under the five relevant steps.



Based on a representative set of readings, this graph indicates the order of accuracy that may be expected from the unit.

This also means that for about 30 per cent of the time, the accuracy is below the figure just quoted. Indeed, there are odd readings which get down to parts in ten million and in extreme cases, due to fading or other unfavourable conditions, the reading will be that of the crystal in the unit, as this will then be temporarily uncontrolled by the VNG transmission. With due regard for the odd bad reading, it will be agreed that the overall performance is very good.

By a happy coincidence, it will be noted that the 4.5MHz transmission of VNG is the image frequency of the 7.5MHz signal and the 6MHz local oscillator. This means that it would only be necessary to retune the two tuned circuits in the front end to switch from 7.5 MHz to 4.5MHz. This may be a worthwhile consideration; the 4.5MHz signal is only on during hours of darkness but it can be very strong for much of the time, and may be an alternative when the 7.5MHz may not be coming in so well.

The process of developing and building this project has quickened our interest in other possible avenues of exploitation. There is at least one very good signal in the VLF range which is available to the Australian scene. This is the installation at North West Cape on 22.3kHz. Already, we have a simple receiver running on this transmission and it is hoped to develop ideas further along these lines, both as another standard frequency reference and also with the possibility of producing a highly accurate timepiece.

Multiplexing LED digital display circuitry

If you are designing digital decoding and display circuitry involving a number of digits, you have the option of using either conventional or multiplexed drive. This short article contrasts the two approaches, explains when each has its advantages, and gives basic circuit configurations.

by GEORGE SMITH

In digital displays, such as would be used in a DVM or counter of conventional design, all digits are operated in parallel, with a separate decoder-driver for each digit operated from data generally stored in a quad latch.

In many cases, a reduction in cost can be effected by operating the display in a time division multiplexed mode. The question of cost effectiveness depends on the particular application. As a general rule, the greater the number of digits in the display, the more advantageous the multiplex system becomes from the cost standpoint. Because of the great variety of situations possible, it is difficult to say at what number of digits the change should be made. In some circumstances, non-multiplexed operation of less than 8 digits is more economical. On the other hand, there are circumstances under which multiplexing is used for three and four digit displays at a cost saving. This article attempts to show some of the many ways of multiplexing digits, and it is left to the designer to decide whether his own system application would be lower in cost if he used a multiplex scheme.

The properties of light emitting diodes (LEDs) make them particularly suitable for multiplexed operation, and hence it is the preferred method to use if a scheme can be designed which is cost competitive with non-multiplexed operation.

Throughout this article, it will be generally assumed that we are talking of a system using TTL type logic families, with MSI functions being used where applicable. In most production situations this will be the most economical approach. There will be some cases where discrete gates and flip-flops may yield a lower cost. There are also cases where a single MOS chip contains all the necessary logic functions, and only interface driver circuits are required.

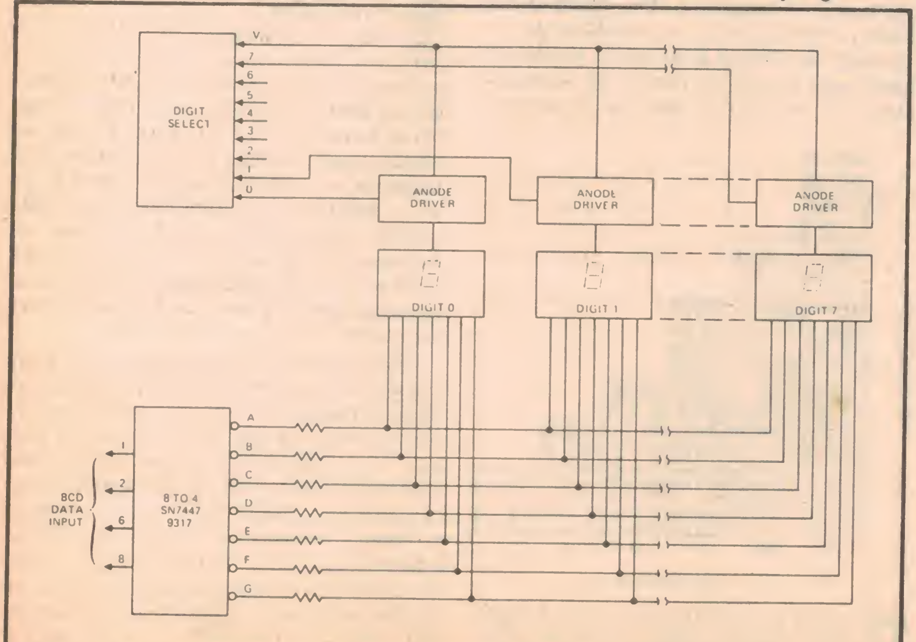


Fig. 1: basic schematic for a seven segment 8-digit multiplex display.

The seven segment numeric displays with a common anode connection made by Litronix Incorporated, USA, provide compatibility with the most widely available decoder-drivers, which are active low level outputs. The most common devices are SN7447, 8T04, 9317 and similar. Any of these is suitable for driving the Litronix DL707 and DL747 type displays. For common cathode displays such as the Litronix DL704 and DL750 types, SN7448, 8T06 and 9307 decoders can be used, and anode drivers become cathode drivers.

In a multiplex system, the corresponding cathodes of each digit are bussed together, and driven from one seven segment decoder-driver, via the usual current limiting resistors. The display data is presented serially by digit to the decoder-driver, together with an enable signal to the appropriate digit anode as in Figure 1.

Each digit anode is driven by a switch, capable of passing the full current of all segments. The simplest switch would be a PNP high current switch or amplifier transistor, such as a core driver type.

In operation, the anode switches are activated one at a time, in the desired sequence, while the appropriate digital data is presented at the input to the decoder-driver. The amount of circuitry required in Figure 1 is much less than that used in the non-multiplexed scheme. The question of overall economy is dependent on the amount of circuitry rerquired to sequence the anodes and present the data at the decoder input. Let us consider some typical situations.

In the first instance, we will consider an 8-digit counter-timer display, with the data stored in multiple latch circuits. This is the most common situation present in a counter-timer of conventional design. A quad latch (SN7475) is used to store each digit, and this data is periodically updated. To scan this data, a 4 pole 8 position switch is required (SN74151). To select the appropriate digit, an octal counter (SN7493) and a 1 of 8 decoder (SN7442) are required. The complete circuit is as in Figure 2.

The total package count is about the same for this arrangement, as for non-multiplexed operation, but most of the packages are lower in cost than the seven segment decoder. The scheme shown pro-

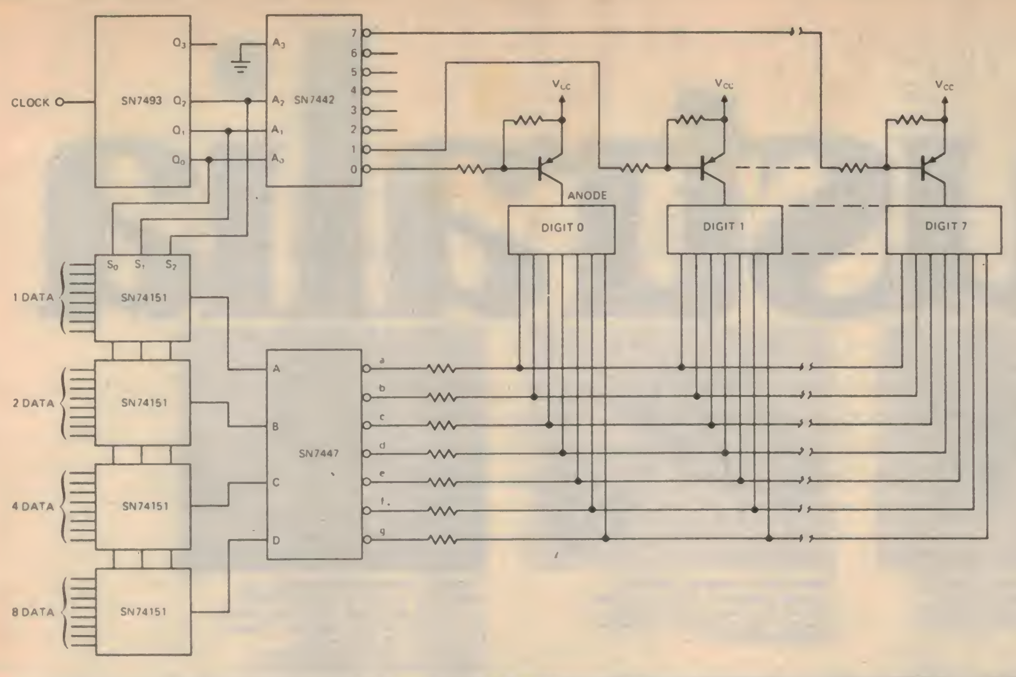


Fig. 2: an 8-digit counter-timer display with the data stored in multiple latch circuits. This scheme results in a cost reduction of approximately 20pc as compared to non-multiplexed operation.

vides a cost reduction of approximately 20pc as compared to non-multiplexed operation. For less than eight digits, it would be difficult to compete with non-multiplexed operation using this scheme.

Multiplexing becomes more attractive, when the data is stored in a shift register, rather than in latches. In this case the data is circulated around the register, at some suitable rate, and is sequentially presented at the input of the seven-segment decoder-driver. The anode drive can be obtained from a counter and decoder as in Figure 2, or from a parallel output shift register as shown in Figure 3.

This circuit, which can be expanded to any number of digits, circulates a single zero, and thus can directly drive the PNP anode switches. Systems using recirculating memories generally require this digit timing circuitry for other reasons, so it is generally available in the system already.

For displays of 8 digits, a very common number in counter-timer instruments, the 9328 dual 8-bit shift register makes a very good circulating shift register. Two packages are required to store and circulate 8 digits, as shown in Figure 4.

This scheme can be extended to more digits by adding a 4-bit parallel shift register, such as the 9300, for each extra digit; the extra shift bits are inserted at the points marked X in Figure 4. The same circuit can be used for less than 8 digits, if a 12½ pc duty cycle is satisfactory. For less than 8 digits, where maximum available duty cycle must be maintained, the scheme shown in Figure 5 can be used.

The preceding schemes demonstrate that systems containing recirculating data are very effectively coupled to multiplexed LED displays. Many multi-digit systems such as calculating machines use LSI MOS circuits to provide their logic, and these naturally lend themselves to recirculating data. It is now practical to use custom LSI to provide the logic functions of a DVM or a counter-timer type of instrument, employing mulitplexed LED displays, at a significant cost savings over conventional instrument designs.

Apart from the strictly logical problems involved in a multiplexed display, the designer must choose suitable operating conditions for the LED's. Peak forward current, current pulse width, duty cycle and repetition rate, are all factors which the designer must determine.

The luminous intensity, or the luminance of GaAsP LED's, is essentially proportional to forward current over a wide range, but certain phenomena modify this condition. At low currents, the presence of non-radiative recombination processes results in less light output than the linear relationship would predict. This effect is noticeable in the region below about 5mA per segment (for 1/4 inch characters). The result is that a noticeable differences in luminance from segment to segment can occur at low currents.

At high currents, the power dissipation in the chip causes substantial temperature rise, and this reduces the efficiency of the chip. As a result the light output versus forward current curve falls below the straight line at high currents (Figure 6). It should be emphasized that this latter effect is entirely due to self heating. If the power dissipation is limited, by running short pulses at low duty cycle, the output follows the straight line up to very high current densities. Whereas 100 A/cm^2 may be used in DC operation, as much as 10,000 A/cm^2 can be used under pulsed conditions, with a proportionate increase in peak intensity. (If this did not occur, GaAsP lasers could not be built.)

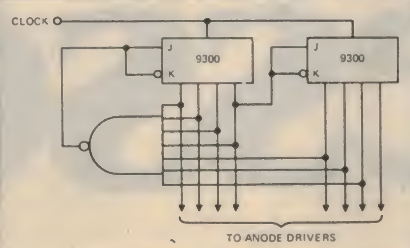


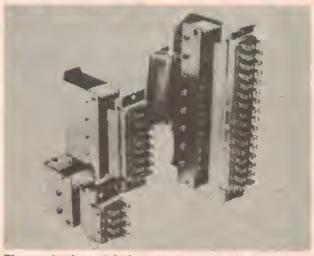
Fig. 3: schematic for a parallel output shift register. This circuit may be used in place of the counter and decoder devices used in Fig. 2.

Gallium Phosphide, however, has an inherent saturation mechanism that causes a drastic reduction in efficiency at high current densities even if the junction temperature remains constant. This effect is due to competing non-radiative recombination mechanisms at high current density.

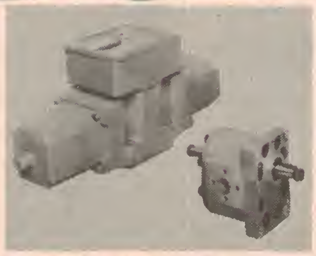
As a first approximation, the brightness of a pulsed LED will be similar to that when operated at a DC forward current equal to the average pulsed current. For example, for 40mA peak current at 25 pc duty cycle, the brightness will be similar to DC opeation at 10mA. The actual brightness comparison will depend on the actual pulsing conditions. Under most legitimate conditions, the brightness will be greater for pulsed operation.

Figure 6 shows how the actual light output at 5mA DC is substantially less than expected from the ideal curve, because of the "foot" on the curve at low currents. Operation at 50mA peak current and 10 pc duty cycle yields a high peak output as shown, and an integrated average output that is much closer to the ideal value. It should be obvious that variations in the "foot" from segment to segment cause a significant variation in light output at a low DC current, but a much smaller variation in the average

Australia



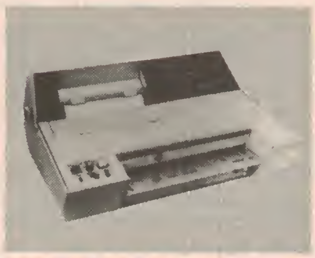
Plessey knife and fork connectors are part of the wide range of multi-circuit connectors marketed by Plessey Australia, Components Division. They are available in standard 20, 40 and 80 way sizes.



Internationally recognised "RACINE" hydraulic pumps and valves are sold and serviced throughout Australia by Plessey Australia, Telecommunications Division, Meadowbank, NSW.

These NEC solid tantalum capacitors are designed for decoupling, by-pass, blocking and filtering applications in both professional and domestic electronic equipment. They are but one of the extensive range of professional components available from Plessey Australia, Components Division.

Illustrated is the MRT 40 mobile 2-way radio system with an SC 201 Decoder fitted. Developed by Plessey Australia Electronics System, Richmond, Victoria, the system employs a method of selective calling whereby each operator receives only those messages specifically directed to him.



Marketed by Plessey Communication Systems, the Facsimile Remote Copier is a desk-top copier capable of transmitting and receiving over public or private telephone lines, printed, written or graphic material within minutes.

This radio paging miniature receiver uses the most advanced electronic circuitry to maximise efficiency in the location of staff. This inductive loop system is available from Plessey Communication Systems.

Designed and manufactured locally, Plessey hydraulic cylinders and presses are available for a variety of industrial and mobile applications. The cylinder illustrated is just one of the wide range available from Plessey Australia, Telecommunications Division, Meadowbank, NSW.

Marketed by Plessey Australia, Components Division the 'Magispark' is a compact electronic gas lighter providing a continuous spark suitable for use in kitchens, on boats, caravans and for outdoor stoves and gas barbecues.

Number of plants: 8
Factory capacity: 1 million sq. ft.
Employees: 4,000

Plessey.

APP70/RI

Multiplexed Displays

output when operated in a pulsed mode.

As well as an increase in luminance, or luminous intensity due to pulsing, there is an increase in brightness because of the behavior of the eye. The eye does not behave as an integrating photometer, but as a partially integrating and partially peak reading photometer. As a result, the eye perceives a brightness that is somewhere between the peak and the average brightness.

The net result is that a low duty cycle high intensity pulse of light looks brighter than a DC signal equal to the average of

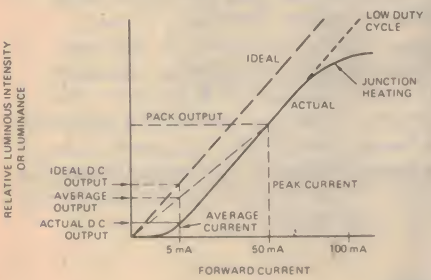


Fig. 6: LED luminance as a function of forward current. Note the departure from the ideal curve at low current levels.

the pulsed signal. The practical benefit of multiplexed operation then, is an improvement in display visibility for a given average power consumption in addition to lower cost. The brightness variation from segment to segment and digit to digit is also reduced by time-sharing. The gain in brightness over DC operation can be as much as a factor of 5 at low duty cycles of 1 or 2pc, and peak currents of 50 to 100mA.

A number of factors must be taken into account when deciding on the design of a multiplexed display. Besides the optical

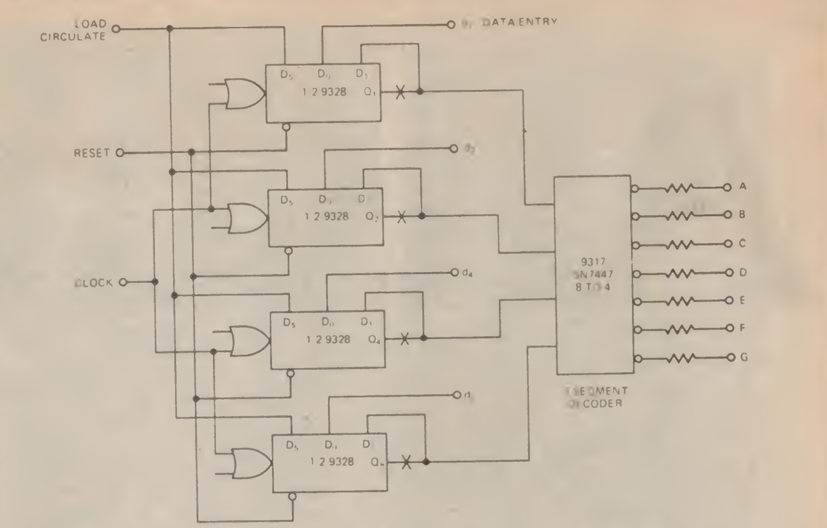


Fig. 4: an 8-digit display using 9328 shift registers to circulate data.

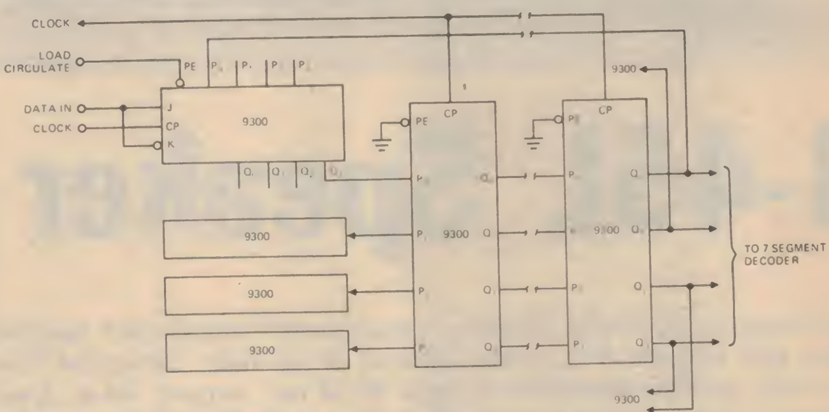


Fig. 5: suitable shift register circuitry for displays of less than 8 digits.

output, thermal considerations are very important.

Most 1/4" size LED numerics are rated at a maximum 30mA DC per segment. Under pulsed operations, higher currents can be used provided several thermal considerations are taken into account as follows:

- The average power dissipation must not exceed the maximum rated power.
- The power pulse width must be short enough to prevent the junction from overheating during the pulse. This implies that the pulse width must get shorter as the amplitude increases.

Present experience indicates that for pulses of 10uS, the amplitude should be limited to 100mA max. Shorter pulses of higher amplitude may be used but the circuit problems become severe if the pulse width is very short. As more information on thermal parameters of the devices becomes available, more specific design rules can be given to assist the designer.

This article has been adapted from an application note published by Litronix Incorporated, California, USA, by arrangement with the local agents CEMA (Distributors) Pty Ltd, 21 Chandos Street, St Leonards, NSW 2065.

US supports Australian designed landing system

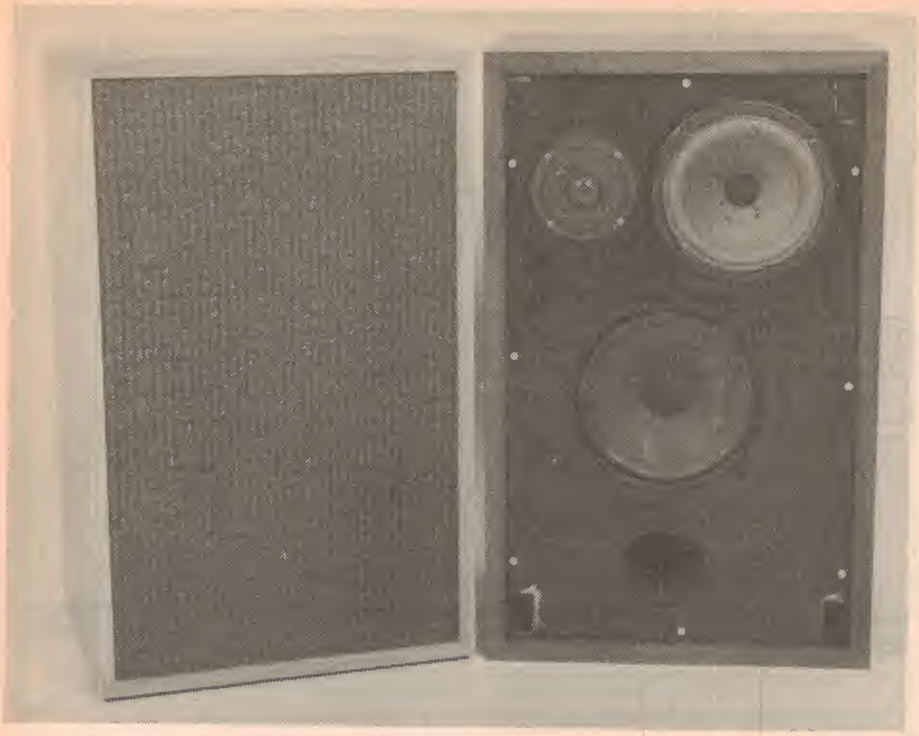
The US Government is expected to support the adoption by the International Civil Aviation Organisation (ICAO) of a microwave landing system for civil transport aircraft based on the Australian designed Interscan system. Britain, France and West Germany have also submitted design proposals to the ICAO which should make a final decision some time next year.

However, the Australian designed system has emerged as a firm favourite for international adoption following a decision by a US Government committee that a scanning beam system, based on Interscan, be chosen for US submissions to the ICAO.

The basic concept of the Interscan system is the result of original studies conducted by the CSIRO into radio astronomy. Development of the system was undertaken in cooperation with the Department of Transport, with the prime contract for prototype equipment, now undergoing installation at Tullamarine Airport, going to AWA.

Basically, the Interscan system uses two antennas to produce electronically scanned vertical and horizontal beams. An aircraft making an approach picks up the beams and measures the time intervals between sweeps, vertically and horizontally, and translates this data into bearing and height information. Distance is measured by an improved DME, a navaid commonly in use, and originally derived from CSIRO and DCA ideas.

Potential worldwide sales of microwave landing equipment has been estimated to be of the order of $US1,500 million.



Combining high quality with moderate cost

The new Playmaster 3-45L loudspeaker system (right) is externally similar to the earlier 2-45L system (left), except that it uses a separate mid-range speaker and is built from somewhat heavier timber. Internally, it has a more elaborate cross-over network. Power handling capability, sensitivity and general balance is similar to the simpler 2-speaker system but definition is better, particularly on some types of program material. We recommend the 3-45L if your budget can stretch to the few extra dollars.

3-45L Speaker System

Continuing our series of up-dated do-it-yourself loudspeaker designs, here's one that we find it very difficult to go past. Expanded from the 2-45L system described on page 39 of our January issue, it will cost just a little more but it comes very close to the ideal for the average hifi enthusiast: moderate size, moderate cost, reasonable sensitivity, ample power handling and a sound that is particularly easy to live with.

by NEVILLE WILLIAMS & DAVID EDWARDS

If we sound keen about this new Playmaster system, it's because we are just that—the more so because it exceeded all our expectations. We've called it the Playmaster 3-45L: 3 loudspeakers and 45 litres.

Subsequent to the release of the Magnavox 2-way systems mentioned in our January issue, the same company suggested a 3-way system which included their 6J loudspeaker specifically to handle the middle frequencies. Because the 6J has quite a high sensitivity, a 15-ohm unit was specified to work in conjunction with the 8-ohm 8-30 woofer and the twin tweeters.

The system went over well with those who were keen on voice and solo instruments but we felt that the middle frequencies were too prominent when reproducing a wide spectrum of sound, as from a full symphony orchestra or a large classical pipe organ. It therefore did not figure strongly in our planning.

Some time ago, however, our work with the 2-45L system encouraged us to think again about a 3-way counterpart. With the Philips dome tweeter doing a particularly good job at the top end, and with a better crossover network to hand, we reckoned that a better case might now be made for a 3-way system. By restricting the top end of the woofer response and the bottom end of the tweeter in a positive fashion, a defined middle frequency area could be produced in which a mid-range loudspeaker would operate. It would be a matter of experiment to establish the mid-frequency level and the general balance of the system.

It was at this stage that we had a call from Mr David Swan of 451 Sound Centre, 451 King Georges Rd, Beverly Hills, NSW. Having heard of our activities through the enclosure manufacturer EKA Industries, Mr Swan said that he had been working on a system along these exact lines and offered to make available some completed boxes which EKA had made up for him, for the purpose.

Basically, the boxes available were of similar dimensions to those specified for a 2-45L system in the January issue (page 38) being dictated partly by styling and partly by the fact that the timber can be cut from available sheets with a minimum of wastage. For the above reasons, the drawing reproduced herewith standardises on these same dimensions. If there is reason to do so, the components could be assembled equally well in the original Magnavox 1.6cu ft enclosure (Jan p.37).

An attractive feature of the boxes made up by EKA for Mr Swan is that they were constructed in part from 18mm timber being therefore preferable to the earlier and lighter EKA boxes mentioned in January. We were glad to note this step in the right direction.

One problem which has to be faced immediately in a 3-way system is how to accommodate a mid-range speaker in the enclosure, while isolating its cone from the back pressure of the woofer. An obvious course would seemingly be to provide the mid-range unit with an unpunched housing, but a likely effect of this is to impose air loading on the cone and to raise the main cone resonance into the frequency range in which the loudspeaker has to operate. Colouration of the sound can easily result.

The problem is compounded by the fact that, at this point, the unit may be

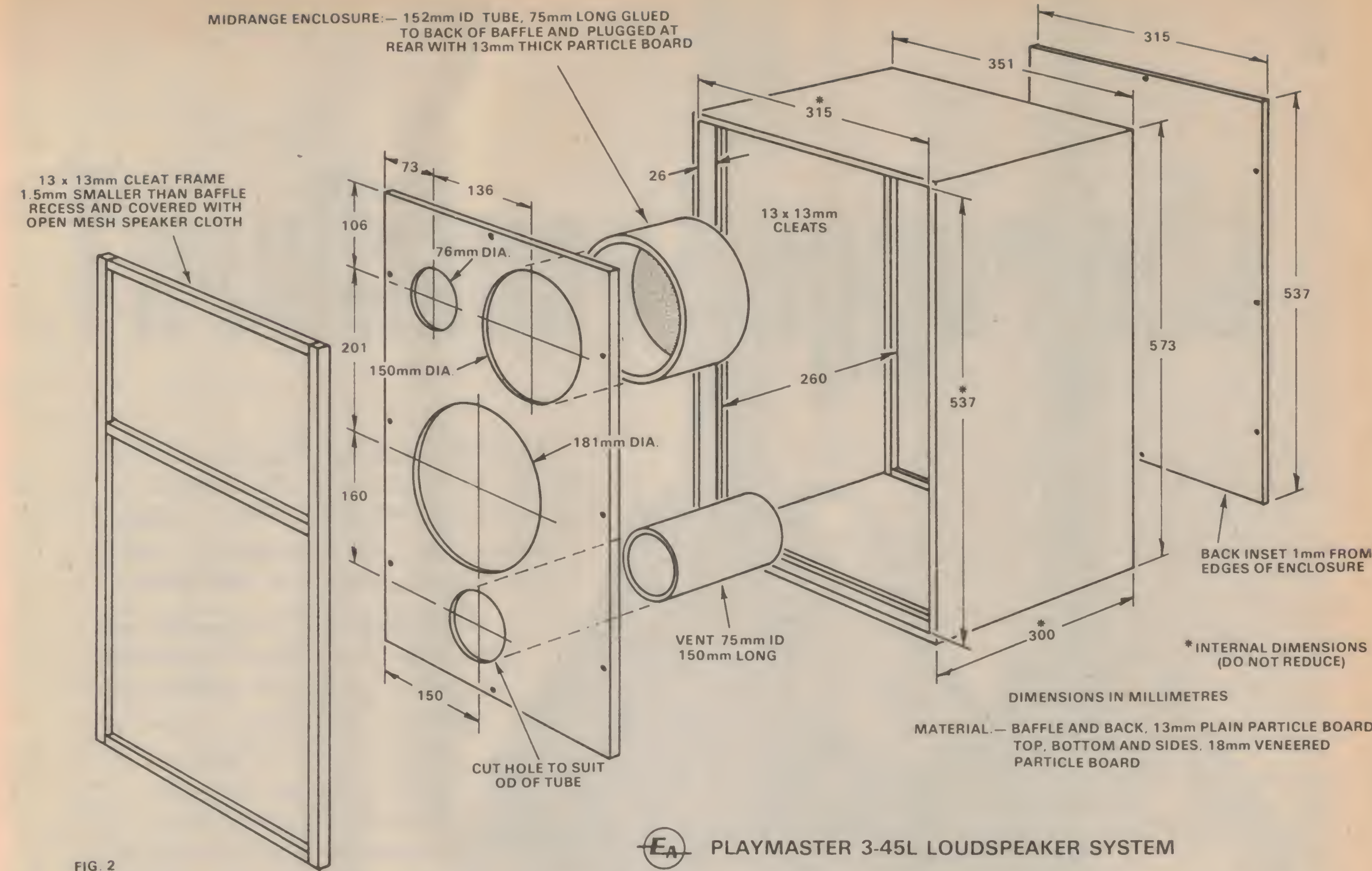


FIG. 2

EA PLAYMASTER 3-45L LOUDSPEAKER SYSTEM

This diagram shows the main dimensional details of the cabinet being marketed for the new Playmaster 3-45L loudspeaker system. A somewhat thicker baffle and back panel could be provided but it may add somewhat to the cost. Normal procedure is to glue and seal the back panel in position, having only the baffle removable. The inner surfaces of the enclosure should be lined with a 1-inch layer of absorbent material, while the small mid-range enclosure should be lightly filled with Innerbond or similar.

partially decoupled from the drive source by the divider network, so that it is robbed of effective electrical damping.

Philips sell a sealed mid-range unit in which the seal takes the form of a large integral plastic shell. Magnavox suggest using an ordinary open back unit but enclosing it in a 3-inch length of 6-inch inside diameter cardboard tube. This is simply butt-glued to the rear of the baffle, the end being sealed with a circle of particle board, also glued in position. In fact, the circle of particle board can be cut from the baffle material removed for the woofer. The loudspeaker itself is mounted from the front.

Lightly filled with Innerbond, the small enclosure isolates the rear of the mid-range loudspeaker, though not without producing a vague hint of a natural resonance at about 200Hz. Nevertheless we adopted the Magnavox suggestion for the prototype system, mainly because we preferred the much greater active cone area.

In due course, with the necessary enclosures and loudspeakers available, we set to work with ears and instruments to investigate the broad approach and to judge whether the extra speaker and components had anything to offer in return.

Restricting the range of woofer and tweeter was largely a matter of substituting different values in the basic networks we had already worked on. For the sake of simplicity, we hoped to avoid the need for a complex network to feed the mid-range unit; a simple series capacitor could roll of its low frequency output as necessary, while its natural response would look after the top end; being a 15-ohm unit to start with, it should not absorb significant power above its working range.

As matters transpired, our main problem with the new system was not with the divider network at all, but in determining the level at which the mid-range loudspeaker should operate. It becomes a problem in a 3-way system mainly because the mid-range is accessible. With a 2-way system it is not, and one reacts favourably or otherwise to the general bass/treble balance. With a 3-way (or more) system, one tends to fiddle interminably, reacting in different ways with different kinds of program material; this notwithstanding measurements!

While members of our staff liked the general quality and definition of the developmental 3-way system, they agreed that the mid-range was still too prominent for the average hifi situation. The system had an impressive "presence" on voice and solo instruments, because the slightly exaggerated mid-range was tending to accentuate them. But, on orchestra, pipe organ, audience applause and electronically generated white noise, what had been "presence" began to qualify for description as "honking". Those familiar with electronic organ terminology settled for the more elegant term "formant effect".

What we finally settled for was a network which dropped the level of the mid-range unit by about 4.5dB. Happily, it also smoothed out the mid-range enclosure resonance at 200Hz, as a result of the more-effective electrical damping.

To our ears, the sound now is particularly clean and very easy to live with in the home. On complex, widely ranging program material it has an open, uncoloured quality. On voice, piano and solo instrumental, there is an ample sense of "presence" which is certainly not based on any exaggeration of the mid-range. In fact, it is this open quality which sets the system apart from any of the 2-way systems we have been listening to of late—and this includes those we have featured in the preceding issues.

It is due, we feel, to the spatial separation of the three sound sources, allowing the listener unconsciously to concentrate when desired on the one which


the rugged rectifiers!
These rectifiers are rugged, both mechanically and electrically. The General Electric A14 (IN5059-62) and A15 (IN5624-27) feature 2.5 and 5 ampere capability respectively, and up to 1000 volts.
POWER-GLAS™ passivation provides a void free inorganic protection of the P-N junction. A dual heat sink glass encapsulated package offers the utmost in long term stability and mechanical integrity. Millions of hours of proven performance attest to the value of General Electric's POWER-GLAS™ passivation process.
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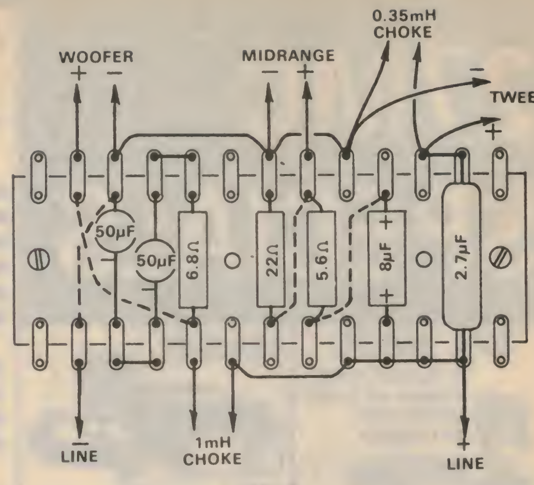
H. Rowe & Co. Pty. Ltd., Perth – 28-5444.
PB Components, Melbourne 53-2766.
The National Electrical & Engineering Co. Ltd., Wellington 553-709, Auckland 599-089.
GENERAL ELECTRIC

3-45L speaker system



The layout of the crossover components is not critical but, for those who like to keep everything neat and tidy, this suggested arrangement on a piece of tagboard may be helpful. When completed, it can be screwed to the back of the mid-range housing. The chokes have to be mounted separately.

FIG. 4

is predominantly carrying the wanted solo sound.

This, of course, could be a highly contentious statement. Considerable virtue has been seen in concentric sound sources and their ability to minimise the phase discrepancies of dispersed sources; but does it also defeat an aural function that can contribute to apparent definition?

And it could provide an argument for adjacent but discrete sources facing the listener—currently the most popular approach—as compared with the omni-directional and reflected sound idea.

It does not follow, however, that 3-way (or more) systems are automatically better on this one score. Too many elements, or elements which are not optimally distributed in the range may defeat listener perception by splitting sounds too many ways. And again, such essentially subtle effects may be totally overshadowed by a lumpy overall response.

These rather speculative observations notwithstanding, we were very happy with the end result and we think that most constructors will react in a similar fashion. For those who may want to experiment with balance, the level of the mid-range speaker can be dropped by about 7dB total by sutstituting 8.2 ohms in series and 10 ohms in parallel with the 6J unit. For a more prominent mid-range, connect 3.9 ohms in series and 39 ohms in parallel. Alternatively, you may want to try the 6J connected directly to the coupling capacitor, omitting the resistive network altogether.

The modification to the network is a very simple one and individuals can set up the system to suit their own tastes. In fact, with a stereo pair of loudspeakers available, they can be set up with different mid-range levels and compared A-B fashion on a mono signal.

Why not a continuously variable pot? Firstly because accessible balance pots on loudspeakers can be a constant source of confusion and annoyance. Secondly, there is the likelihood that altering a simple volume control would change impedance with setting sufficient to change the low-end roll-off of the mid-range unit.

Fig. 1 shows the electrical circuit of the finished system. The R/C circuit shunting the woofer makes it look like a substantially constant impedance. Fed through a 1mH choke, the woofer begins its "copy-book" roll-off at 500Hz and is 3dB down at 1kHz.

At the other end of the spectrum, the tweeter rises through its 3dB point at just above 5kHz, carrying on to beyond the limit of audibility.

The mid-range loudspeaker fills the gap between these two nominal crossover frequencies—nominal because they depend on the speaker's acoustic output, which is a function of the relative level of signal fed to it, and its inherent response characteristic.

One very convenient aspect is that, being a 15-ohm unit, it does not unduly compromise the impedance of the system as a whole at those frequencies where it is electrically in parallel with the tweeter. System impedance remains at or above 8 ohms up to 6kHz, dipping to a minimum of just below 7 ohms at 9kHz.

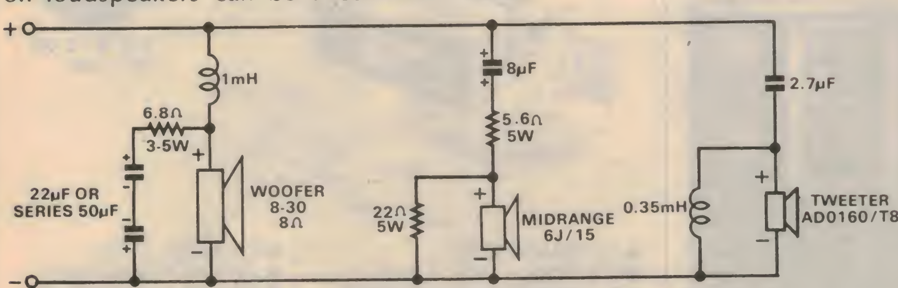


FIG. 1

The electrical circuit of the Playmaster 3-45L loudspeaker system. The linearising capacitor across the woofer is not particularly critical and back-to-back 50uF electrolytics will do if a 22uF non-polarised is not available. The 8uF in series with the mid-range unit should be within about 10% either a non-polarised electro intended for crossover networks or a polyester or polycarbonate type. The 2.7uF should also be a plastic type. See text re the mid-range resistive network.

Fig. 2 indicates the basic dimensions recommended for the Playmaster 3-45L loudspeaker enclosure, for the sake of those who may want to build their own from raw materials. The panels may be butted, mitred, and assembled with or without cleats, depending on individual resources and the method of final finishing.

Probably the best approach is to assemble the sides, top, bottom and back into one integral box, rigidly glued and screwed (or pinned) and made completely airtight. It can be provided with neatly fitted cleats to receive the baffle and fret frame from the front, and with airtight connections for the external leads.

It should be lined inside with a 25mm layer of Innerbond or similar material. While we have favoured this material exclusively in the past, it has been pointed out that other materials such as fibreglass or new carpet underfelt are suitable for use in padding the walls of ported enclosures. (They should not, however, be regarded as a substitute when filling sealed enclosures, as distinct from padding the surfaces.)

With the padding pinned or glued in position, and with the outer surfaces finished as desired, the enclosure can be put aside and attention given to the baffle carrying the internal "works".

Four holes need to be cut in the baffle as shown, for tweeter, mid-range, woofer, and port tube. If you have difficulty in obtaining the last-named item, ask someone who works in an office where copying machines are installed; the paper rolls often come on spools of 3-inch inside diameter.

The face of the baffle and the inside of the holes and port should be painted flat black—blackboard paint is an obvious choice. Later, the outer edge and pad ring of the mid-range loudspeaker will need to be treated similarly so that it will not show through the fret cloth.

Large diameter tubing suitable for housing the mid-range loudspeaker is manufactured, these days, for such purposes as casting concrete pillars. Seal one

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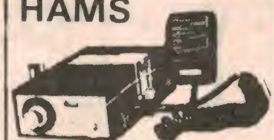

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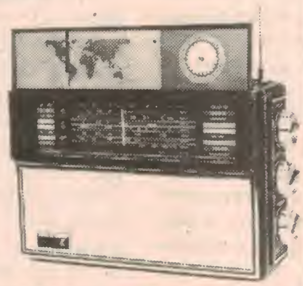

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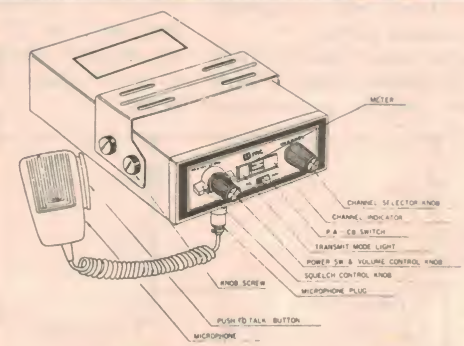

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end of the tube with a piece of surplus baffle material and then butt-glue the assembly to the rear of the baffle, centrally over the mid-range loudspeaker hole.

It would be possible to contrive an equivalent enclosure by other means but it should enclose the mid-range loudspeaker snugly, while occupying as little space as possible inside the main enclosure.

Before screwing the mid-range loudspeaker into place, make provision to take leads out through the back of the sub-enclosure. Coloured wires passed through snug-fitting holes will do, or drive a couple of brass nails through, so that you can solder to both ends. Fill the sub-enclosure with Innerbond or similar—not carpet felt or other dense material—then screw the mid-range speaker in from the front. It does not need any special kind of sealing around the rim, since back pressure inside the small enclosure is not a serious problem.

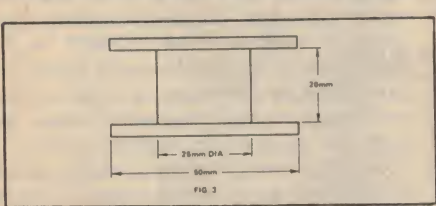


FIG 3

The chokes can be wound up on bobbins made to these dimensions from plywood, masonite or other non-metallic material.

The tweeter also needs to be mounted from the front, but against a complete circle of non-hardening caulking compound, or a ring of adhesive foam plastic. The tweeter body has to provide a seal against the back pressure of the woofer and a simple flush fit will not necessarily be adequate.

As far as the woofer is concerned, it can logically be mounted on the rear face of the baffle, taking care to see that any spaces in the pad ring or around the screwholes are caulked. If mounted on the front of the baffle, the 8-30 needs to be bedded against a ring of caulking compound or adhesive foam. In addition, a much deeper fret frame is necessary to keep the cloth clear of the cone during extremes of its travel.

Having fitted the loudspeakers, the frequency divider components can be added. The two chokes can be wound on our usual non-metallic bobbin (plywood, masonite, wood, etc) as shown in Fig. 3. They can be wound with 18B&S or 19SWG gauge enamelled wire, putting on 197 turns for 1mH and 118 turns for .35mH.

The actual layout of the components forming the frequency divider network is not critical, the one important thing being that the right connections are made. If you want to be totally "informal" lugs can be fastened where necessary to the rear of the baffle, or brass screws can be driven half in to act as anchor points for the circuitry. For a neater job, the smaller components can be mounted on a tagboard as in Fig. 4, the chokes being attached at convenient points to the rear of the baffle.

Note that we have specified 5W resistors in the network, contrasting rather obviously with the 1W types found in some commercial units. In ordinary circumstances the lower wattage types would probably be quite adequate and their compactness and economy are significant in a commercial product. As an item in a complete do-it-yourself product, higher wattage types add very little to the overall cost and they won't mind if you feed the system with high level tones at critical frequencies!

In this system, all loudspeakers are shown connected in phase, mainly because we could not establish a case for doing otherwise. A comparison of the drive voltages on a double-beam CRO indicated that phase displacement between drive voltages was never in excess of 90 degrees, and certainly nothing like the 180-degree shifts credited to steeper filters. Nor could we hear any advantage, in listening tests, in alternative connections.

What if you want to build up the Playmaster 3-45L system without starting with raw materials? Readers in the Sydney area at least should be able to obtain a complete enclosure, speaker and crossover kit from Mr David Swan, as mentioned earlier in the article. The company involved is: 451 Sound Centre, 451 King Georges Rd, Beverly Hills, NSW 2209. Phone 57-8654. If desired, completely built-up systems are available. We understand that the company is prepared to supply customers in other areas with kits or fully built-up units, by arrangement.

Other suppliers will possibly make their own arrangements for partial or complete kits and these could save a lot of chasing for odd items like pieces of cardboard tubing. We would stress, however, that the Playmaster 3-45L is one which involves a particular enclosure, a particular combination of loudspeakers, and a particular divider network—all put together in the recommended fashion.

What we have said about it applies only to the recommended system. Obviously, many other combinations of loudspeakers are possible and they may variously be good, bad, or indifferent; we could not possibly attempt to evaluate all the likely permutations and combinations. What we are saying here is that, if you want a system of this general class, the Playmaster 3-45L is one that we can recommend.

SUPER-BASS SPEAKER
Watch out for a forthcoming article which will really get through to organ and hifi fans addicted to large helpings of fundamental bass. Hifi writer Bernard Simpson tells how he satisfied the urge!

Forum

Conducted by Neville Williams

Electronics is a serious business!

April has come around once again and, following upon our experience last year, it will probably pass without any technical tomfoolery on our part. But I must confess that, for a while, a couple of items that landed on the editorial table caused us to ponder whether we were being set up.

Last year Dick Smith, of Dick Smith Electronics, was beset by a screamingly funny idea, which brightened the whole month of March—for him! In his April advertisement, he would publish what purported to be working, printed integrated circuit. The instructions would suggest cutting it out, and allowing it to soak in salt water until it became saturated . . . dry enough to attach to a scrap of aluminium . . . attach leads . . . etc.

The doubtful deed was duly done, with one precaution: the experimenter was advised to hold the pattern up to the light—whereupon he would be greeted by the words coming through from the opposite side "April Fool". The trouble was that the weight of the printing made the words rather less obvious than had been intended and a lot of people didn't follow the instruction anyway!

So we copped it, and Dick Smith copped it from readers who didn't like having their legs pulled.

But Dick Smith has made amends in this issue with a free catalogue!

That was A.F. joke number 1. The second must be laid at the door of Jim Rowe and Phil Watson who came across a gag in the News Bulletin of the Hurstville Branch of the Australian Postal Institute: "Changeover To Metric Time".

If you thought Dick Smith could chortle, you should have heard the two staff members in question. They dressed the item up with an April 1 dateline and prepared to share the fun with E.A. readers.

Unfortunately in the new climate of litres, grams and kilometres, some people took it seriously—as a further and ridiculous example of the lengths these metrication people were prepared to go! There were spirited arguments over breakfast, and around the lunch-time billy, some of which seemed to have stopped just short of divorce and fisticuffs. So we copped it again!

Against that, a correspondent's silly suggestion, on these pages, for quadraphonic headphones was completely outclassed. No one even got hostile!

Perhaps it all goes to show that technical people like to find their amusement in places other than the pages of a technical journal!

It was against this kind of realisation that we faced up to a letter from a reader from Thornbury, Vic:

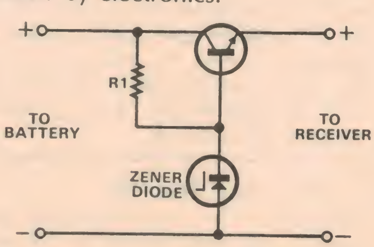
Dear Sir,

Could you please sell me plans for a light beam transmitter that can reach 50-100 miles. I have heard that you can adapt a public address system for the purpose by using a light in place of a speaker. Is this true?

I am also after a Voice Operated Morse Code Sender and an electrically operated shutter system for code sending, the system to be operated by the above VOMCS.

I would appreciate any help you can give me.

Our first reaction was that the reader was having us on for April. Subsequently we decided that he was probably quite sincere and that he had been misled by a combination of half truths and a conviction that, these days, most things are possible by electronics.



Circuit of the basic "Battery Miser" suggested by an overseas magazine. Unless we've completely missed the point it will have just the opposite effect to that intended.

It is a fact that speech and music signals can be superimposed on a light beam, and that it could be done by adapting a public address system. Further, by using a higher order of technology, television and other kinds of signal can be transmitted very successfully from point A to point B, with light as the carrier.

But, having said that, it is necessary to remember that we are, indeed, talking about light beams—which are very easy to set up over a few metres, but which become progressively more difficult as the distance is increased. Better sources and better reflectors can obviously help, after which it may be necessary to upgrade to laser technology. But even laser beams can be interrupted by smoke, rain or solid objects. And, even if this can be tolerated to an extent, distance alone must ultimately put the would-be terminal sites beyond the range of visibility.

That is why, at the moment, so much work is going into fibre optics—tiny ducts along which light can pass in much the same way that electrical current flows along a metallic wire. In fact, optical fibres can be run just like wire leads, over considerable distances, around corners, overhead or underground. And because light has such a very high frequency, an enormous amount of information can be modulated on to it—far more, for example, than on to an electrical coaxial cable.

Optical communication using (fibre) ducted light may one day take over from today's masses of metallic cables but this is far removed from the ideas and aspirations of our correspondent.

Similarly, his request for a voice-operated Morse Code sender can only be met by the retort: "impossible". In fact, if anyone could come up with a means to turn human speech into any kind of predictable, rational code capable of being interpreted by a machine, they would trigger an enormous revolution in communication, computing, and control technology.

As it is, the most ambitious attempts to "talk" to machines, the most way-out research, is still at an elemental level. It is one thing to make a machine react in a formalised way to a small range of sound patterns; it is quite another to understand, interpret and react logically to ordinary, everyday speech.

Until that problem is solved, humans must break their own speech down into impulses or codes which machines can react to—by using keyboards or Morse keys.

And, at the other end of the link, there is a parallel situation. A computer can be programmed to produce a limited number of formalised word sounds as, for example, the command "pull up" when an aircraft is approaching an obstacle. But, beyond that, a machine can only print out letters, or display them on a screen, or produce audible beeps, or operate a Morse sounder. Someone still has to read the message and enunciate the words.

The other item that set me back was an article in an overseas magazine entitled "Battery Miser". I really did check on the dateline to see whether it read "April"; but it didn't and I can only assume that the author was quite serious.

The theme of the article could be summarised thus: batteries are now relatively expensive items and some portable radios can be "ravenous" in terms of current consumption, especially if operated at high volume from a new (e.g. 9.5V) battery. However, receivers tend to draw less current at a lower supply voltage, this leads to the thought that one might effect an economy by determining the lowest supply voltage at which a given receiver will operate satisfactorily and arranging that it will never receive more than this voltage from the supply battery. A very simple circuit is available which makes this possible, as shown in Fig. 1. It might typically be set up to provide 6V from a 9V battery. The basic requirement would be to choose a zener with a rating slightly higher than the desired voltage and to choose a value for R1 such that about 0.5 to 1mA will flow through it.

Well, that's the idea. Let's take a dispassionate look at it.

One might concede that an economy might result for the kind of user who knows only one mode of operation for a portable receiver: "flat out", irrespective of needs or environment. By making sure that the set could never be fed with more than, say, 6 volts, the drain on the battery would be limited electrically, no matter how far the user tried to force the volume, distortion notwithstanding.

But, having conceded this possibility, let's look at the situation for a listener who operates a receiver more intelligently. This is surely not an unreasonable quality to attribute to people who might be sufficiently concerned to want to build a "battery miser".

As envisaged by the author, most portable receivers use a class-B output stage and this accounts for most of the battery drain, with drain being closely related to operating level. Let's assume that, in round (and easy) terms, the overall output/input efficiency is 60%. And let's assume that the listener needs an average output of 60mW to provide a suitable level of sound in his particular listening situation. The power input required to provide this will be about 100mW, average.

Drawn from a 9V source, this would involve about 11mA average drain. Theoretically, with a fresh battery at 9.5V, the user could obtain the required output at 10.5mA drain. I know that this is splitting straws but it does indicate that, on a "needs" basis, and to the degree that one can judge needs in terms of loudness, higher voltage can actually offset current drain. But let's ignore the fine point and simply agree that the current drain will be about 11mA at a nominal 9V input.

Now let's consider the other extreme where the supply voltage to the receiver has been reduced to 6 volts. Let's assume also that the user still wants his 60mW average output, to be loud enough, or to overcome ambient noise. That means 100mW of input and therefore an average current drain, at 6 volts, of 16.7mA.

If the set was operating from a 6V battery source, that would cause no concern, because one would expect the supply to comprise fewer but larger cells. But this extra current is coming from the original 9V battery via the Battery Miser. In fact, if the zener current is added, the effect of the Battery Miser would be to boost the current drain for a given level of receiver output from 11mA to about 18.5—from the original battery!

But that's not all. The author suggests a 2N2297 silicon transistor in the circuit, which will involve a series voltage drop of about 0.6V. This means that the receiver will receive 0.6V less than the battery can deliver as it runs down towards the end of life point—however that is determined. If the name of the game is to get the most out of the battery it can only be a liability to have a built-in 0.6V drop in the supply line.

So there you have it: a battery "economiser" circuit which may typically push up the initial battery drain by 50% and which may also hasten the end of life situation. Having in mind the shape of battery life/drain curves, it could result in about a 2:1 reduction in battery life.

Curiously, the author draws attention to the voltage drop in the transistor and suggests, further, that the dissipation ratings should be 200-250mW for the zener and 150mW or more for the series transistor. He seems blissfully unconcerned that all these milliwatts must come from the battery he is trying to conserve, and that in magnitude the figures (right or wrong) exceed the consumption of typical portables.

We would suggest that there's a less hazardous way of conserving the batteries in portable radios; a way that involves no additional circuitry and is valid for all voltage levels:

Go easy on the treble cut so you don't throw away clarity; run the volume no louder than you really need; turn the set off when you're not listening to it! Then you might really double the life of your batteries.

Be your own "battery miser".

Electronic voting possible but . . .

Dear Sir,

I would like to reply to the letter by M.F. in the February issue for two reasons: (1) To comment on the EID (Electronic Instant Democracy) system and (2) To voice a defence of the Australian Electoral Office.

The matter is of interest to me because of personal political involvement and professional involvement with a computer. I have also discussed with a member of the Electoral Office the use of computers in their business—a sore point at present due to teething problems in the current process of putting the electoral rolls on tape.

My conclusion is that it is technically possible to record votes using a computer and also to count votes and determine the result. The kind of terminal I had envisaged involves the normal polling booth equipped with a sufficient number of voting machines, probably in the form of video input terminals with a card punch. It would be cheaper than M.F.'s system but more expensive than the present one.

While most people would like to know the result of a ballot immediately, the major limitation at present is actually the waiting period for postal and absentee votes—up to 10 days.

An electronic system does not, as often assumed, ensure greater freedom from error. Present procedures are such that, to my knowledge, it is virtually impossible for a person to be enrolled or vote twice, or to be unfairly excluded from voting. Papers are checked so rigorously that a recount seldom changes the figures except as a result of classification: valid or invalid. This is a matter of judgment and is usually the basis for court challenges.

In an electronic system, there is a distinct possibility of error at both programming and hardware level, as well as that of someone "rigging" the result, as you mentioned. In my proposed method, printed cards would be punched by the voting machine and, after examination by the voter, would be placed in the ballot box. In the event of a failure or challenge, checks would be possible in the conventional way.

Electronic systems have other disadvantages as, for example, the effect of "machines" on voters. While many are used to keyboards, etc, such systems would be baffling to many others—the unskilled, the disadvantaged and the elderly.

As you suggest, an instant vote on many issues would have debatable value.

As anyone who has scrutineered will know, the Electoral Office is scrupulous and meticulous at all times, particularly under the extreme pressures of an election situation. It is thanks to this loyal and unswerving attitude that we have the smooth and watertight system that we have at present.

(Sgnd. B.R., Division of Science and Technology, Tasmanian College of Advanced Education.)

The Serviceman

Do you need a new aerial?

As might have been expected, the advent of colour TV has resulted in a crop of stories on misconceptions, misquotes, half truths, and, I suspect, wishful thinking. This article discusses one of the more controversial ones currently doing the rounds.

This one started early in the piece, and is to the effect that a new aerial is virtually essential when a colour TV set is installed. I don't know how it started. Suspicion would fall naturally on the aerial manufacturers, and their desire to sell more aerials.

But I suspect it is not as simple as that. To be sure, the manufacturers have emphasised the need for an adequate aerial for colour reception, and the possibility that the aerial installed for a black and white set some 10 or 15 years ago may have deteriorated. Unfortunately, by the time statements of this kind appear in feature articles in the daily press, they are likely to have lost something in the translation; hence the implication that it will be "essential" in "every" case.

Anyway, from where I stand it has created a confused public; I have lost count of the number of times I have been asked questions on this subject. My general attitude is to advise caution. More specifically, I point out that the standard of black and white picture they are now receiving is a very good indication of the kind of colour picture they will receive.

If they are getting a good black and white picture, free from ghosts, free from snow, and having good sharp definition, then there is every chance that they will get first class colour pictures. If there is snow it may be due to a poor aerial or a poor receiver. If there has always been snow then it is most probably a location problem, perhaps aggravated by an inadequate aerial. On the other hand, it may be a location problem for which there is no simple answer.

Where snow has developed over a period of time it could be due to steady deterioration of the receiver, or the aerial, or both. Only a detailed examination of both will answer the question.

Ghosts are, of course, essentially an aerial problem—something which many customers find hard to understand, or are not prepared to accept. If a particular aerial and location produces ghosts on a black and white set then it will produce the same ghosts on a colour set. And the degree of distraction on the colour set will be about the same as for the black and white set. Most observers agree that it will not be worse; some even suggest it may be less.

This, then, has been the basis of my advice—and that of most other servicemen that I know—possibly varied to suit individual customers or locations where I could draw on practical experience. But in the light of this, the experience I am about to relate proved confusing and disconcerting, to say the least.

It wasn't a service call in anything like the usual sense of the term; more like an advisory service trying to solve a problem by remote control.

The person concerned was a social acquaintance, but not a customer; he lives too far out of my territory. In fact, he lives only about three miles from the Sydney transmitters, but slightly below the brow of a hill which prevents an actual line-of-sight situation.

He is a reasonably handy type, with at least a good general knowledge of things electronic. About two years ago he asked my advice about an aerial, though without much thought of colour at that stage. At my suggestion he purchased a popular type featuring high and low band folded dipoles linked together, plus a generous assortment of directors and reflectors.

"Now you pick out the best picture Ma'am, and I'll stop on that one." (Radio-Electronics.)

While it may have been rather more elaborate than necessary in one sense, considering the signal strength, it featured a good back-to-front ratio and minimum side lobes; always a good precaution against reflections from large buildings etc, now or in the future.

At the same time he purchased a length of aluminium mast, 300 ohm feeder, chimney straps, and other necessary odds and ends of hardware. Putting the thing up wasn't the easiest job he'd tackled. The height of his building and the slope of the ground was such that he needed to borrow a 30ft extension ladder from a neighbour to reach the chimney. Then he had to get used to working nearly 30ft up with little to hang onto.

He also discovered that a TV aerial on the end of a mast can be the most awkward thing imaginable when one is trying to manoeuvre it from such a precarious perch. In spite of all these problems he eventually secured everything in place, pointed the aerial in approximately the right direction, and returned to terra firma. (The more firmer the less terror, as some wise guy once remarked!)

Anyway, that was the end of the story at that stage. The aerial gave first class pictures on the black and white set, and the whole exercise was regarded as a successful, if mildly traumatic, one.

From then on the aerial was more or less taken for granted, even when early last November, shortly after the first test programs went to air, he purchased a colour set. As far as he was concerned the aerial was still delivering a first class black and white picture and should, therefore (by my say-so), deliver first class colour pictures.

But first came the ritual of installing the colour set. The technician assigned to the job made a great feature of a check list which he carried, supposedly designed to ensure that no aspect of the installation was overlooked. In my friend's opinion, a lot of the items were included more to make an impressive list than for any real value. Questions such as, "Is the set plugged into the power point?" (tick), "Is the aerial connected?" (tick), "Is the colour control advanced?" (tick), seemed, to him, to be quite trivial.

Be that as it may, the system did seem to break down where more important matters were involved. Such as whether the set would receive colour, for example. It so happened that there were no colour signals available at the time of installation, so the question, "Is colour reception satisfactory?" was answered with a letter code indicating a lack of test signals.

Fair enough, except that no arrangement was made to return and adjust the set when suitable signals were available. It was only when my friend phoned the company concerned and asked a few pointed questions that the technician was sent back to finish the job at a time when signals were known to be available.

Meanwhile, back at the first visit, the technician continued through his check list. Eventually he came to one, "Is the aerial satisfactory?" Without the benefit of any tests, examination, or colour signals he wrote "No" without the slightest hesitation. One can only assume that any aerial, unless it was brand new, would be regarded as unsatisfactory.

After the first visit, some colour programs were received but, unfortunately, only at times when my friend was at work or away from home for other reasons. His family tried to give him some idea of the quality but, as he put it, "The information non-technical people are able to give in such cases, is almost valueless."

Subsequently, the technician made his second visit and completed the adjustments using a colour pattern. Again, this happened while my friend was at work, so he was unable to satisfy himself that everything was correct before the technician left.

After this, performance was erratic. While some colour programs were received, and were quite good, at other times no colour could be received even when it was known that colour was being transmitted. Channel 10 was worst, no colour being available at all, while channel 2 suffered both intermittent colour and picture rolling.

To make matters worse, the company which had installed the set were not very co-operative. As far as they were concerned, the trouble was due to the aerial and until a "proper" aerial was installed, they would not accept responsibility for the set's performance.

"OK", said my friend, with some exasperation, "can you quote me a price to install such an aerial?"

"We can't quote you", they replied, "but we can recommend an aerial installation firm that will."

Still not convinced that a new aerial was necessary, my friend simply thanked them and said he would leave it for the present. But he did seek out another aerial installation firm and obtain some general cost figures from them. They quoted him between $40 and $50 for an aerial, according to type, plus $12 labour cost for the first hour, and $7 an hour thereafter.

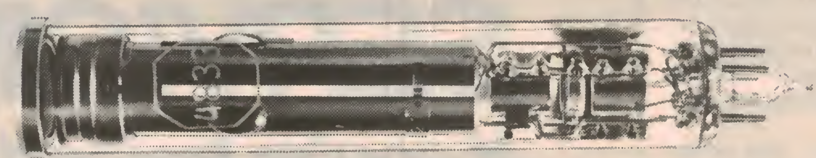
Now, while these figures may not be unreasonable in themselves, my friend resented the idea of incurring this cost if it wasn't really necessary; if, in fact, his reasonably new aerial was adequate and the fault was really in the set.

At this point he approached me again and brought me up to date on the story as I have just told it. In particular, of course, he wanted to know what kind of aerial fault would allow a set to deliver first-class black and white picture but not colour.

To be honest, I had to admit to being baffled. The only aerial fault I knew of which would permit black and white reception, but not colour, was one where

CCTV

Surveillance Camera Tube



(Shown actual size)

$4\frac{1}{4}''$

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AD42

the bandwidth of the aerial was inadequate. While it may seem to be stretching things to suggest that an aerial could be so selective that it would lop off the chrominance signal, I have heard reports from overseas that this can happen.

Apparently some very low cost aerials, intended for black and white reception in strong signal strength areas were little more than simple dipoles (as distinct from folded dipoles) and, if used in marginal signal conditions, could give an acceptable black and white picture, but not colour.

But this didn't seem a logical explanation for the present problem. This was no cheapjack aerial of skimped design, nor was it a poor signal area; quite the reverse in both cases. In these circumstances I just could not offer an explanation as to why the aerial would discriminate between black and white and colour.

Left to his own devices, my friend decided that the orientation of the aerial might not be optimum. While he knew the general direction of the transmitters, he could not see them. He had originally pointed the aerial in the general direction and, when it worked, he didn't bother any more about it. Now he decided to be a bit more precise.

One of his possessions was an old army compass. Moving round to one side of the obstructing hill, to where he could see the towers, he took bearings on them. Since the aerials are scattered there was a difference of some 24 degrees between the two furthest apart, so he split the difference.

Back home he estimated the likely error due to his observation point and set up the aerial according to the mid position of his compass readings. As far as he could tell, this did improve the signal strength somewhat, but channel 2 was still rolling.

At this point he decided that the only thing to do was take the aerial down and check that there was nothing obviously wrong with it. So out came the neighbour's 30ft ladder from under the house and a major exercise was mounted to lower the aerial to the ground.

Close examination of the aerial produced a major surprise. Although it had appeared to be intact, and for the most part it was so, the all-important feeder connections were a mass of corrosion. One had actually broken adrift, though it is possible that this happened in the process of lowering the aerial. The other one broke away at a touch, suggesting that it was being held by little more than the corrosion. In short, it seemed likely that whatever signal the set was receiving was being picked up by the feeder.

My friend wasn't too sure just how this would prejudice colour reception, but he didn't need to be told it was wrong. Glad to have found a possible fault he attacked the corrosion with penetrating compound, spanner, screwdriver, and whatever else was necessary. Having cleaned away the muck he fitted new screws, nuts, washers etc, and reconnected the feeder. Then it was up the ladder again and try to preserve a sense of balance while refitting the mast to the chimney.

The job completed, he waited eagerly for the next scheduled colour transmission. When it arrived colour came up in all its glory and remained steady throughout the program. Subsequent programs, from other channels, were similarly well received, and it seemed clear that the faulty aerial must have been responsible.

When he first told me the good news, I must confess to being puzzled. As far as I could see, the fault had to be one which discriminated against the chrominance information, in terms either of frequency or sensitivity, or perhaps some of each. But, as I understand it, signals have to be approaching the snowy region before colour reception becomes dicey, and my friend assured me that there was no suggestion of snow. I'd have been surprised if there was, aerial fault notwithstanding.

Which left some form of frequency discrimination. After a good deal of thought, the only explanation I could come up with was the possibility that the length of the feeder just happened to be such that it functioned as a very effective trap at the sub-carrier burst frequency.

I realise that this theory leaves some questions unanswered. For example, while it might be possible to sustain it for any one channel, how could it happen on all four?

Frankly, I don't know. All I know is that a faulty aerial apparently caused loss of colour, while giving a good black and white picture, and that fixing the aerial fixed the fault.

But that was not the end of the story. At the time he rang me he had not had a chance to check colour on channel 10. Subsequently, when they radiated a colour program, a new problem arose. The set would receive the colour all right, but the picture would no longer lock vertically. Yes, that's right; channel 10 was received normally when radiating a black and white picture, but would not lock vertically immediately they switched to colour.

This threw me for a while; I simply couldn't imagine what possible connection there could be between the addition of colour to a signal and a set's inability to lock. I pondered on the problem for the rest of the day and most of the evening, and eventually hit on what at least seemed a possibility.

When the set was installed the aerial was in very poor condition and delivering a (relatively) weak signal. The AGC control would have been set on the basis of this signal but, subsequently, the aerial was overhauled and would have undoubtedly been delivering a much stronger signal; one which may have been so strong that sections of the IF system were overloaded to the point of severe sync pulse clipping.

Now suppose that, on channel 10, the clipping was so severe that there was barely enough sync pulse left to maintain vertical lock. Now add the chrominance sub-carrier. Would the extra energy be sufficient to increase the clipping from a barely acceptable condition to a complete loss of pulses?

I had no way of knowing, of course; it was just a theory. But I felt it was worthwhile passing on to my friend. Accordingly I rang him at the first opportunity, explained my theory, and told him where to find the AGC control and how to adjust it.

I would like to report that this proved to be the solution to the problem. Unfortunately I can't. I'm not sure whether I failed to get the message across, or my friend was not able to follow me—and thus did the wrong thing—or whether he did all the right [illegible] but that my theory was wrong. [illegible]way, it didn't solve the problem.

I didn't hear from my friend for several weeks after that. When I did it transpired that, apparently, he had become somewhat impatient about the whole situation and finally consented to let the set manufacturer nominate a firm of aerial specialists to investigate the problem.

Their immediate reaction was that the aerial was quite unsuitable for channel 10 and was the reason that the picture would not lock when this station transmitted colour.

The upshot was that they supplied and fitted a new aerial. ("And it cost a b----- fortune", to quote my friend.) And somewhere along the line the problem vanished. So, in spite of the cost, my friend is happy and the aerial firm demonstrated, at least to their own satisfaction, that the original aerial was unsuitable. After all, the problem vanished when a new aerial was fitted.

But I wonder. I still find it hard to believe that an aerial fault could be responsible for such symptoms. I even took the opportunity to talk to a former TV-antenna design engineer and he, likewise, found the explanation hard to accept. He was more inclined to support my theory about the AGC control.

Maybe I'm uncharitable, but I can't escape the suspicion that, after the new aerial was erected, the set would have been put through a "routine adjustment" procedure. And that, if that same procedure had been adopted before the new aerial was fitted, there may have been no need to fit it!

Anyway, until someone can provide me with a convincing explanation as to how the faulty aerial could cause rolling on colour transmissions, I reserve my decision.

Interfacing EDUC-8 with a Philips 60SR printer unit

Continuing the discussion of interfacing peripherals with the completed EDUC-8 microcomputer project, the author describes here the interfacing necessary for a Philips 60SR mosaic printer unit. With such a printer, your computer is able to print out messages, requests or the results of calculations in easily read form.

by JAMIESON ROWE

Most computers have a printing unit of some kind among their output peripherals, to allow them to communicate easily with a human operator and at the same time provide a permanent record of their interaction. With small machines there may be only the printing section of a teletypewriter, while larger machines tend to have one or more high-speed line printers as well.

Interfacing with a printer thus tends to be an integral part of most computer systems, so that the description of our EDUC-8 educational computer system would not really be complete if it did not include a discussion of this aspect. Even if you don't actually get around to obtaining a printer and hooking it up to your computer, I hope you will find the discussion of interest and value.

I have selected the Philips 60SR mosaic printer unit as the basis for discussion, for two main reasons. One is that it appears to be the only small printer unit offering a full alphanumeric character set which is readily available at the time of writing. The second reason is that Philips Elcoma very kindly made a sample unit available, to allow me to test and debug the power supply and interfacing circuitry!

The 60SR printer must be bought new, and as such will cost you considerably more than surplus paper tape gear. In fact, together with its associated electronics module, it will cost more than the EDUC-8 computer itself. This shows how far the cost of computers has fallen, thanks to modern IC technology, while the cost of mechanical peripherals like printers has tended to remain static. The cost differential is likely to increase even further in the future, unless we see some breakthrough in technology which will allow precision machinery to be made more cheaply.

In any event, the 60SR printer appears to be the most economical way of providing full alphanumeric printout facilities for a small computer like EDUC-8. The only possible exception would be a surplus teleprinter, but these are in very scarce supply.

As shown in the photograph, the complete printing unit consists of the 60SR mechanism itself, together with two PC boards forming its associated CM64 electronics module. One PCB, known as the CC64 character circuit, provides the read-only memory (ROM) and scanning logic necessary to generate any one of 64 different alphanumeric characters, when commanded. The other PCB provides the power stages to drive the printer head solenoids from the CC64 output lines; it is known as the AC64 amplifier circuit.

The 60SR printing mechanism is a compact one, designed to print lines of up to 20 characters in length on paper 60mm wide. It takes readily available rolls of paper, as sold for adding machines and printing desk calculators. It takes standard typewriter ribbon, although an alternative version (60SA) is available which takes pressure-sensitive paper, and does not use a ribbon.

The character printing is not performed by the familiar raised-symbol hammers or "golf-ball", but by a set of seven blunt-tipped needles which strike the paper from the rear and force it against the inked ribbon. The needles are arranged in a vertical column, although the solenoids which drive them against the paper are disposed horizontally.

The needle and solenoid array form the printing head, which is driven horizontally across the paper by a small synchronous motor. As the head travels across the paper, the needle solenoids are driven by the scanning electronics so that they produce the desired characters as a pattern of dots. Each character is formed as the head moves through approximately 1.5mm, corresponding to five needle-widths, and thus consists of a pattern of dots selected from a matrix or mosaic 7 dots high by 5 dots wide—hence the name "mosaic printer".

One advantage of this method of printing is that there are a very small number of moving parts compared with a conventional typewriter or teletypewriter mechanism, giving improved reliability. The fact that the characters are "formed" by the scanning electronics also makes such a printer very flexible, because the character set may be changed easily by exchanging the ROM in the electronics for another.

As a result of these advantages, mosaic printers are becoming increasingly used, and seem likely to replace other types eventually. The 60SR printer is therefore very much an example of "upcoming technology", as far as printers are concerned, although only a small one.

The printer mechanism uses four synchronous motors. One is for head drive, one for paper feed, and the remaining two for ribbon feed. The motors are controlled by a number of microswitches, connected as shown in Fig. 1. Note that switches C, A and B are operated by a bistable "memory bar", which is moved between its two stable positions by the printer head at each extreme of its travel. Similarly switch G, controlling the direction of rotation of the ribbon motors, is controlled by a second "memory bar" which senses ribbon tension.

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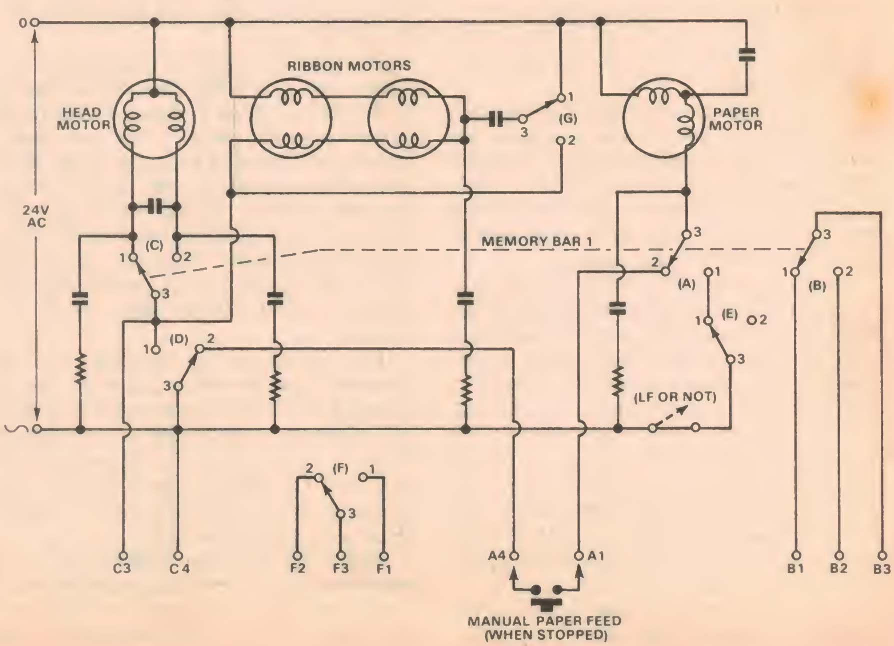
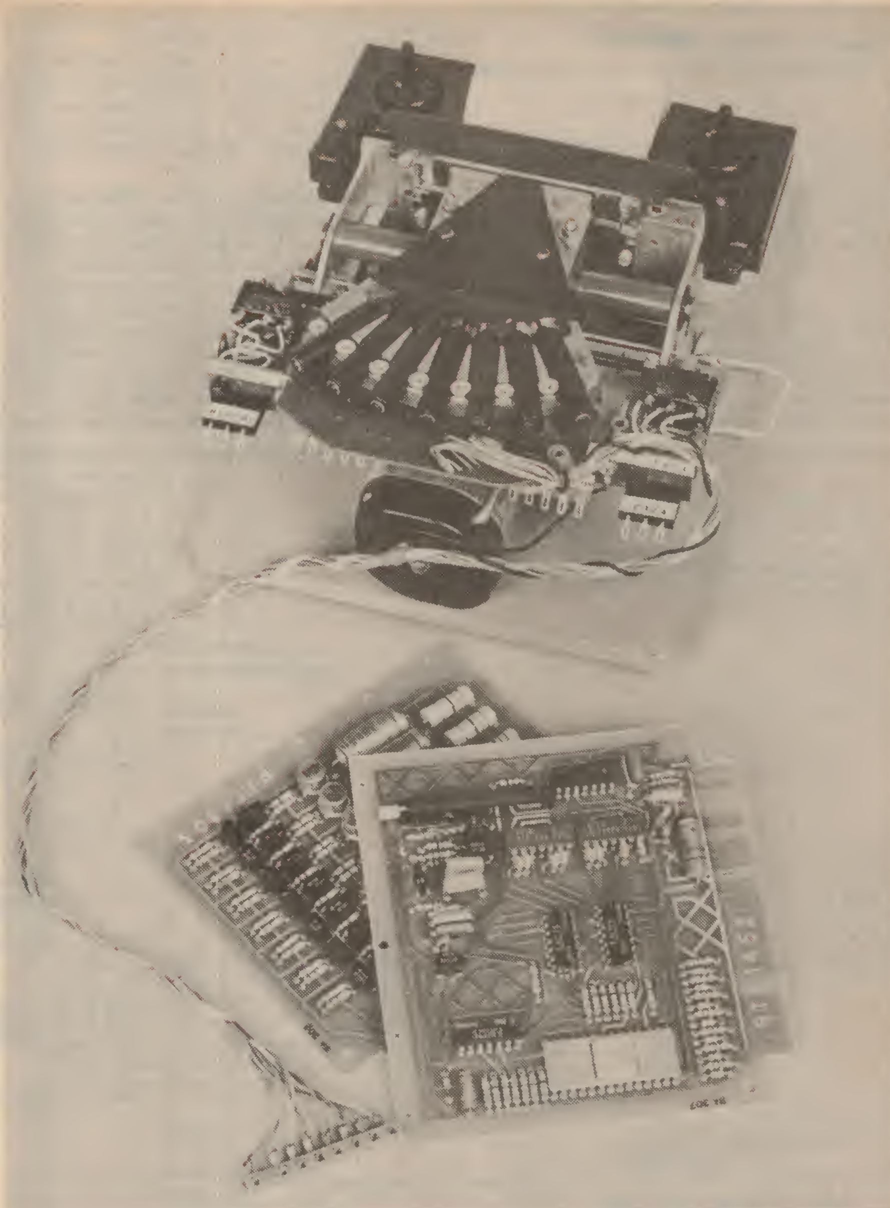
HELLO, I'M EDUC-8 --
SPEAKING TO YOU VIA
THE PHILIPS 60SR
MATRIX PRINTER
```

Above is a sample of the print-out, reproduced actual size. Fig. 1, below, shows the printer motor circuits.



This is the complete Philips printer package 60SR printer mechanism, CC64 character generator board, and AC64 driver board. Only a small amount of additional logic is needed to drive them from the EDUC-8 computer.



Switch D is used to sense whether or not the printing head is in its resting or "home" position, at the extreme left-hand side of the paper; it operates as soon as the head leaves this position. Switch F is arranged to operate when the head has moved a short distance from the home position, when the drive motor has reached full speed; it is used to signal the electronics module that printing may begin. Switch E is operated by the printing head near the right-hand extreme of its travel, and is used to time the operation of the paper feed motor.

The operation of the mechanism for a typical printing cycle is as follows. Initially the printing head is in the home position, and the switches are all in the positions shown. The cycle begins when terminals C3 and C4 are connected together externally, completing the head motor circuit through contacts C1-3.

The head motor starts turning, and moves the head away from the home position. Switch D then operates, closing contacts D1-3 and thereby latching the head motor circuit for the remainder of the cycle. This ensures that operation is independent of the external C3-C4 contacts, as soon as they have initiated the cycle.

After about 80 to 100 milliseconds the head motor has reached its full synchronous speed. The position of switch F is such that it is now operated by the head, and this can be used to indicate to the electronics module that printing can begin. As the head continues to move across the paper at constant speed, the solenoids then drive the printing needles against the paper under the control of the electronics module, printing the desired characters.

When the head nears the end of its forward travel, switch E is operated, opening contacts E1-3 and closing E2-3. This has no immediate effect, but serves to prevent the head motor from operating the instant that the head reaches the end of its travel and operates the main memory bar. When the bar is operated, it reverses switches C, A and B.

Switch contacts C1-3 are opened and contacts C2-3 closed, causing the head motor to reverse. The printing head thus begins moving back to its home position.

The reversal of switch A at the end of the forward head travel causes contacts A2-3 to open, and contacts A1-3 to close. However because contacts E3-1 are open, there is no immediate effect. It is only when the head has moved back towards its home position by a short distance, releasing switch E, that the paper motor is energised via contacts A1-3 and E1-3. The paper motor thus begins to feed the paper up, bringing the characters just printed into view and at the same time advancing the paper for the next line.

The paper motor only operates for a short time, however; just enough to advance the paper by about 5mm. It stops as soon as the head completes its return to the home position, operating the memory bar once again and reversing switch A.

Shortly before the head reaches the home position it operates switch F, forcing it back to its resting position to prevent restarting of the electronics module until the head has regained full speed in a new cycle. And finally when the home position is reached, switch D is operated along with the memory bar switches, resetting all switches to their initial positions and de-energising the head motor until a new cycle is triggered by external closure of C3-C4.

During the whole of the cycle the ink ribbon motors have been energised along with the headmotor, via contacts D1-3. They have therefore moved the ribbon along as required, in a direction determined by the ribbon memory bar and switch G.

You will no doubt have noticed that switch B plays no direct part in the operation of the printer mechanism. Like switch F it is provided for control of the electronics module, primarily to inhibit printing during the return travel of the head.

Note that the operation of the paper drive motor during the cycle may be inhibited, if desired, by opening the connection between switch contact E3 and its 24V supply rail. The paper may also be advanced manually, if desired, by using an external pushbutton or switch to join contacts A1 and A4 when the printer is stopped.

The CM64 character module provides all of the character generation and head driving electronics for mosaic printers like the 60SR. It has a repertoire of 64 different alphamumeric and punctuation symbols, which are generated in response to the application of a 6-bit character code number and a "start printing" (L) command pulse.

The 6-bit code used to specify which character is to be printed is a sub-set of the American Standard Code for Information Interchange, or "ASCII" code. A chart of the 64 characters available, together with the 2-digit octal equivalent of their 6-bit selection code numbers, is shown in Fig. 2. This table was actually printed by the 60SR printer itself, under the control of a small program running in the prototype EDUC-8 computer.

The heart of the CM64 module is the character generation ROM on the CC64 PC board. This is a 2240-bit device, organised as 64 35-bit words. Each of the 35-bit words is pre-programmed with the 5 x 7 mosaic dot pattern for a printing character. The 6-bit character selection number fed to the CM64 module is used as an address for the ROM, to determine which of the 35-bit words is made available to the scanning circuitry.

The scanning circuitry consists of a start cir-

cuit, a scanning oscillator, an 8-bit shift counter and a decoder, and a set of gates controlling the ROM data outputs.

When the START PRINTING (L) input is applied to the module, this triggers the start circuit which enables the scanning oscillator. The shift counter begins counting, and its outputs are decoded by the decoder to sequentially select each of the 5 groups of 7 bits in the 35-bit ROM word corresponding to the vertical columns of the character to be printed. When the ROM data outputs stabilise each time, the output gates are enabled to allow the 7 bits concerned to pass to the AC64 driver circuits, and thence to the head solenoids.

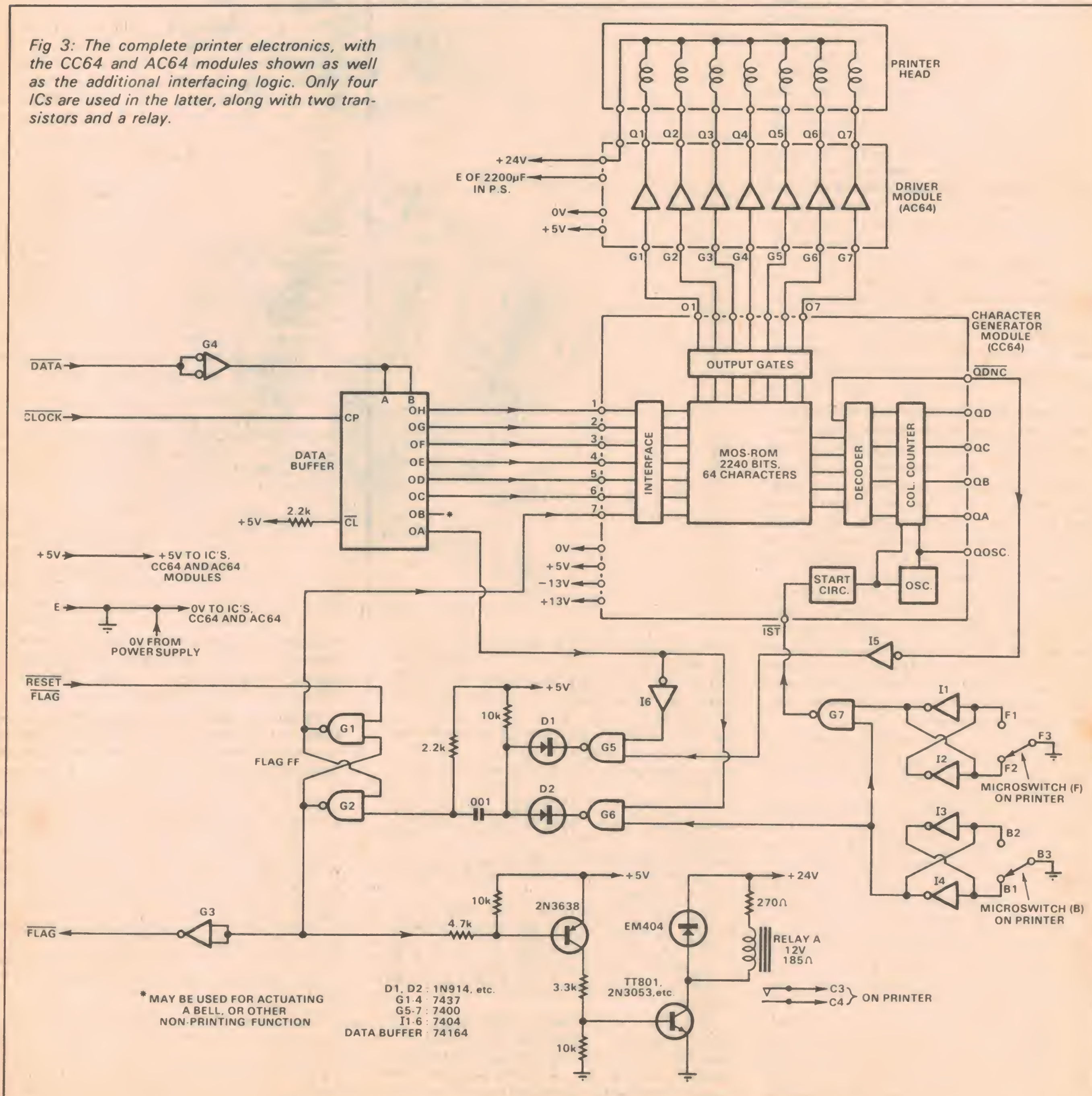
The dot information for each of the five vertical columns making up the character are thus read out and fed to the printing needles, one after the other, so that the character is printed as the printing head moves along the paper.

After the fifth column of data is read out from the ROM, the decoder generates a "Demand new character" (L) output pulse at the QDNC output, to signal that the current character has been printed and another should be supplied. At the same time the output gates are inhibited, so that the printing needles are prevented from operating. This continues for two scanning oscillator cycles, giving a space after each character equivalent to the width of two columns. The scanning oscillator is then turned off, so that the scanning cycle for that character ends.

The scanning oscillator runs at approximately 400Hz, so that the columns of the characters are read out at approximately 2.5ms intervals. The exact scanning/printing rate can be adjusted, by means of a preset potentiometer on the CC64 PC board, to give between 18 and 20 characters per line.

Note, by the way, that the Philips 60SR printer is rather different from a teletypewriter, in that once the mechanism has begun to print a line, it must complete that line. This means that one cannot simply feed individual characters or words to the printer, at any convenient time. If you do so, it results in each character or word occupying a separate line, a rather wasteful and hard to read printout format!

Fig 3: The complete printer electronics, with the CC64 and AC64 modules shown as well as the additional interfacing logic. Only four ICs are used in the latter, along with two transistors and a relay.



EDUC-8 INTERFACING LOGIC FOR PHILIPS 60SR MATRIX PRINTER

To achieve the more usual and tidy format of having the characters and words grouped together to form reasonable length lines, the individual characters must be supplied to the CM64 module one after the other, as requested by the "Demand new character" signal. This means that before sending the first character of a line to the printer, you must make sure that the remaining characters for the line are available, to be sent after it at intervals of approximately 20ms.

The "whole line at a time" requirement of the 60SR printer does tend to make it a little unsuitable for certain applications, such as echoing an input keyboard. It also tends to complicate other applications such as printout of a text string, unless a "trick" is pulled in the interfacing logic. More about this shortly.

The AC64 amplifier circuit PCB of the printer electronics consists of the seven driver stages for the printer head needle solenoids. The driver stages turn on their appropriate solenoids, when selected, for the last half of each column scanning interval—about 1.25ms each time. The solenoids operate from 24V DC, each drawing approximately 850mA when activated. The peak current from the 24V supply can therefore be as high as 6A during a 1.25ms printing interval (for example, when a full column of dots is being printed), but due to the 1:1 mark-space ratio and the variations between characters, the average peak current is nearer 1.5A.

The interfacing logic I have developed to connect the Philips 60SR up to the EDUC-8 computer is shown in Fig. 3. As you can see, it is fairly straightforward, and uses only 4 low-cost ICs, two transistors, a relay and a handful of minor parts.

You have probably identified by this stage the two main parts of the logic, because they are similar to those used in previously described peripherals: the flag FF, formed by gates G1 and G2, and the data buffer register, formed by the 74164 8-bit register.

The six least significant bit outputs of the 74164 data buffer register are connected to the six ROM address inputs of the CC64 character circuit, so that 6-bit words fed from the computer may be used to specify which of the 64 characters available is to be printed each time. The seventh "inhibit" input of the CC64 is connected to the flag FF, so that the ROM is not actually allowed to sense the address code until the computer resets the flag. This prevents spurious operation as the 6-bit data word is shifted into the register from the computer; by the time the flag is reset, the data word is fully settled in the buffer.

The two transistors form a driver circuit for the relay, which is used to activate the printer mechanism start contacts C3-C4. The input to the driver circuit is taken from the flag FF, so that the relay closes the circuit between the printer contacts whenever the flag FF is in the reset state. Thus when the computer resets the flag after feeding out a character code number, the printer mechanism is started at the same time as the ROM address inputs are enabled.

Note that the flag resetting does not itself trigger the start circuit of the CC64 character circuit. This is because the actual printing must be controlled by the printer mechanism. Hence if the character fed to the circuit from the computer is the first of a new line, printing will not begin for some time after the flag is reset—until the printer signals via switch F that the head is up to speed.

The START PRINTING (L) signal applied to the 1st-bar input of the CC64 board is supplied by G7. This acts as an AND gate, fed by signals derived from printer microswitches F and B via

PHILIPS 60SR
CHARACTER CODE
(77 FORMAT OCTAL)

CHAR	CODE	CHAR	CODE
@	00		40
A	01	!	41
B	02	"	42
C	03	£	43
D	04	$	44
E	05	%	45
F	06	&	46
G	07	'	47
H	10	(	50
I	11	)	51
J	12	*	52
K	13	+	53
L	14	,	54
M	15	-	55
N	16	.	56
O	17	/	57
P	20	0	60
Q	21	1	61
R	22	2	62
S	23	3	63
T	24	4	64
U	25	5	65
V	26	6	66
W	27	7	67
X	30	8	70
Y	31	9	71
Z	32	:	72
[	33	;	73
\	34	<	74
]	35	=	75
^	36	>	76
_	37	?	77

Fig 2: A listing of the characters in the CC64 character generator's repertoire, together with the corresponding octal equivalent code numbers. As you can see, the listing was printed out by the 60SR printer itself, controlled by EDUC-8.

bounce suppression flip-flops. In contrast with the bounce suppression flip-flops in previous peripherals, these use inverter elements (I1-I2 and I3-I4), but work in the same way. Inverters are used here merely for economy.

Due to the action of G7, the CC64 start circuit is triggered into operation only for that part of the forward head travel in each printing cycle between the operation of switch F (signalling that the head is up to speed) and the reversal of switch B (signalling the end of forward head travel). It is prevented from being triggered during the entire return travel, and also for the first 100ms or so of the forward travel, before the head motor reaches full speed.

Gates G5 and G6, inverters I5 and I6 and diodes D1 and D2 are used to control which of two available signals are used to set the flag FF, to signal to the computer that a new character is required.

Predictably, the "demand new character" signal from the CC64 board QDNC-bar output is one of the two signals, this being provided by the CC64 decoder precisely for such purposes. And this is in fact the signal normally used. It is fed to the input of G2 via I5, G5 and D1, and then via the differentiating circuit formed by the .001uF capacitor and the 2.2k resistor.

The differentiating circuit is necessary because the signal from the CC64 output is approximately 2.5ms long. If this were applied directly to the flag, it would block the flag in the set state for the equivalent of more than 25 computer instruction cycles. As a result the computer would keep sending new characters, in the mistaken belief that the printer was keeping up! The differentiating circuit prevents this from taking place by effectively converting the signal into a much shorter pulse—about 2us—derived from the leading edge of the longer signal.

While setting the flag in this way using the "demand new character" signal is entirely adequate for many purposes, it is not sufficiently flexible to permit efficient and convenient printout of text strings. This is because of the "one full line at a time" requirement of the 60SR mechanism, which has no facility for executing a carriage return before the end of the line.

If the "demand new character" signal were the only signal available to set the flag, this would mean that each line of a text string would have to be ended with a number of spaces, designed to ensure that the printer did not reverse in the middle of a word. It would be tedious in the extreme to work out the number of spaces required for each line. Also, as the spaces must be stored in the computer's memory along with the rest of the text string, they would take up valuable memory space.

It is to avoid this that I have provided the alternative flag set signal. This is derived from the printer microswitch B, again via the bounce suppression flip-flop formed by I3 and I4, and is applied to the G2 input via G6, D2 and the differentiating circuit as before.

When the logic selects this flag set signal instead of the "demand new character" signal, the flag FF is not set until the printer head completes its current printing cycle, and returns fully to the "home" position. This means that the character whose code is currently applied to the ROM address inputs is simply repeated until the end of the current line. The printing electronics is then inhibited as usual during the return head travel, and the flag FF is reset only when the cycle is complete.

Thus if the code for space (octal 40) is applied to the ROM address inputs, the effect of selecting this alternative flag set signal is to automatically fill in the end of the line with spaces.

The selection of the two alternative flag signals is performed by the data word itself, fed into the buffer by the computer. This is possible because while the computer handles 8-bit words, only six of the eight bits are required by the CC64 ROM to specify the required printing character. The two remaining bits are thus available for auxiliary control functions, and I have used one of these to perform the required selection of set signals. The bit used is the most significant one, available at Oa of the buffer.

Thus if a character is to be printed normally, with other characters to follow in the current line, this is achieved by leaving the most significant bit a zero. This has the effect of inhibiting gate G6, but enabling gate G5 via I6. Hence the "demand new character" flag set signal is selected.

On the other hand if the character is required

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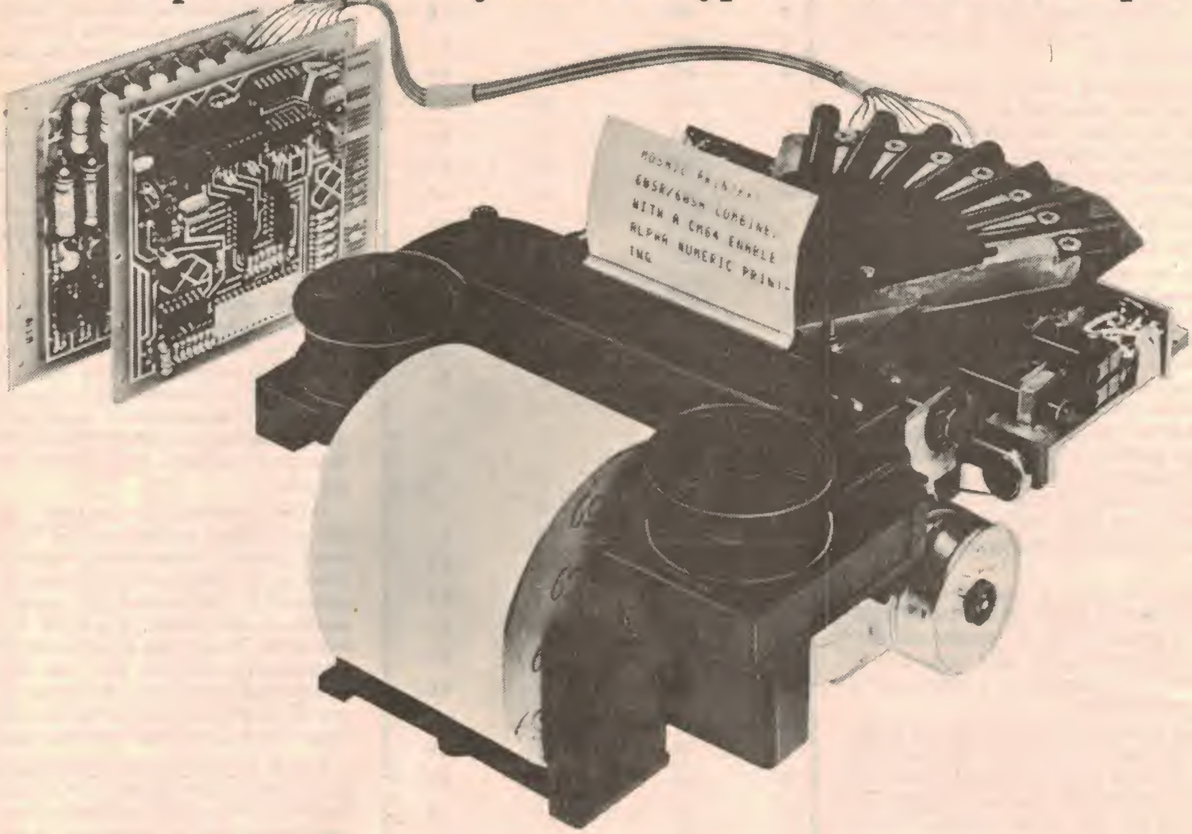

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to be repeated until the end of the current line, all that is necessary is to make the most significant bit of its code number a one. This causes gate G5 to be inhibited, and gate G6 to be enabled instead, so that the "end of cycle" flag set signal is selected.

It may not be immediately apparent, but this facility greatly increases the efficiency and convenience of the printer. For example all that is necessary to end each line in a text string is to store a single "repeating space" (octal code 240). This is simple, convenient and economical in terms of memory space.

In effect, a "repeating space" becomes the functional equivalent of a carriage return—line feed combination with other printers, and offers most of the flexibility this gives.

But this is not all, because the repeating facility may be used with any of the 64 characters in the 60SR's repertoire. And because you can make such a repeated character the first—and only—character of a line, this makes it possible to "stretch" a single character into a line the full printing width of the paper.

Thus for a line of asterisks all you need is a single character, with the octal code 252. Similarly code 255 gives a line of dashes (minus signs), or code 237 a line of underlines—either of which makes a very suitable way of providing top and bottom rules for list-out tables, etc. And the beauty is that they only require a single character code!

Note that the character repeating facility uses only one of the two "spare" data word bits, so that there is still one bit available for controlling any other function you may care to add to the printer. All that is necessary is to take the output from Ob of the 74164 data buffer, and provide the required circuitry.

One possibility would be to have this bit control the line feed facility of the printer, by using another small relay to perform the switching function shown dashed in Fig. 1. The relay could be driven from the Ob output of the data buffer via a transistor driver circuit rather like that shown for the printer start relay.

Another possibility would be to provide the printer with a "bell" facility, so that the computer can alert the operator when desired. Again this would involve a transistor driver circuit rather like that used for the printer start relay, in this case driving a small electric bell—or perhaps a Sonalert.

If you would like more than one such additional facility this could also be done, by using a one-of-four decoder driven by the two spare bits, rather than use the two bits direct. A suitable decoder would be one-half of a 9321 device, driven from the Oa and Ob outputs of the 74164. The existing flag reset logic could be driven from the "2" output of the decoder, leaving the other three outputs for the additional control functions. But note that as the outputs of the 9321 decoder are active low, the inverter I6 would need to be swapped over into the G6 gating input line, from the G5 gating input.

There are five distinct power supply requirements for the printer peripheral as a whole. The printer mechanism itself needs 24V AC, at a current of around 420mA. The printing needle solenoids and the relay run from 24V DC, with an average current requirement of around 1.5A (6A peak). The electronics in the CC64 circuits requires +13V DC at 30mA and −13V at 0.5mA, while +5V DC at about 370mA is required for the CC64, AC64 and the interfacing logic.

Of the five supply requirements, only the 5V DC supply is available from the computer, via the IOT connector cable. The remaining four must be supplied by a separate power supply built into the printer unit, and the circuit developed for this is shown in Fig. 4.

With a little ingenuity I have been able to provide all four of the required supplies from a single power transformer, one having two secondary windings each rated at 12V/1.33A. The transformer actually used is the Ferguson type PL30/40VA, one of their "low profile" 40VA family. This actually has two 15V windings, tapped at 12V, and it is the 12V portion of each winding that is used here.

The two windings are connected in series to form a centre-tapped 24V winding, which directly provides the 24VAC required for the 60SR printer mechanism. At the same time a bridge rectifier is connected across the full winding, and this is used both to produce both floats at half the main bridge output voltage. A simple shunt regulator using a 13V/1W zener is used for regulation, with a 2200uF/16VW electro across the output to reduce ripple to an acceptably low level.

Note that because the transformer winding floats at a DC voltage of approximately 18V above earth, neither side of the printer mechanism wiring may be earthed. This has no adverse effects, and no complications in terms of interconnections with the electronics—the contacts of the printer start relay simply float with the printer circuitry, while the contacts of microswitches F and B connect only to the logic circuitry, and not to the printer circuit.

A separate half-wave shunt rectifier circuit connected to one side of the transformer winding is used to produce the negative supply voltage. Again a 13V/1W zener diode is used for regulation, and a 2200uF/16VW electro for improved filtering.

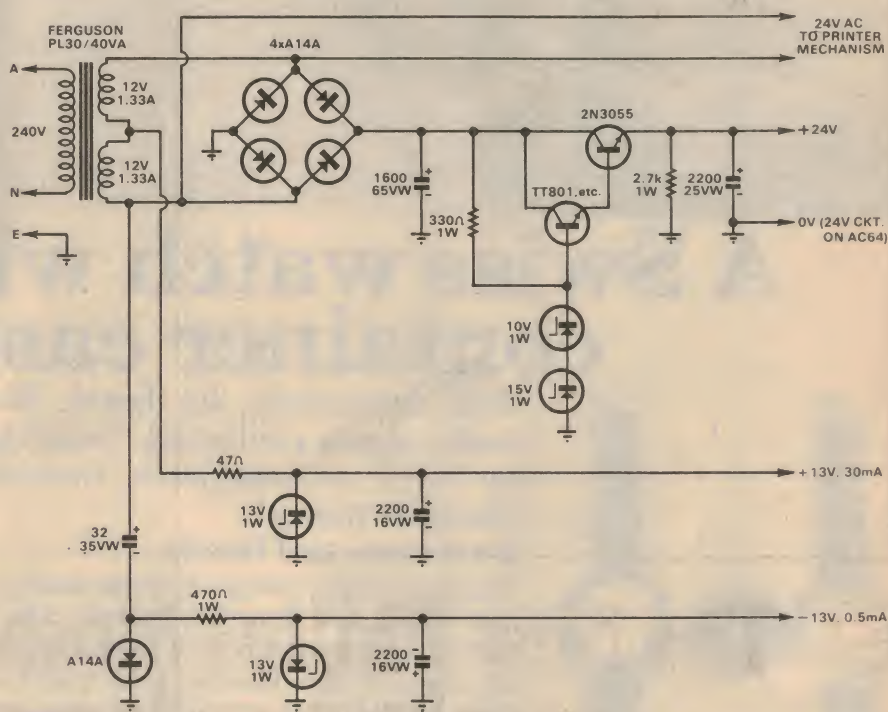

Fig 4: The power supply circuit for the printer. This provides 24V AC for the printer motors, 24V DC for the relay and needle solenoids, and two 13V DC supplies for the CC64 character module.

the 24V solenoid-relay supply and the low-current +13V supply.

The full output from the rectifier bridge is fed to a 1600uF/65VW reservoir electro. A simple series-pass regulator circuit is then used to regulate the output at the required 24V. The series-pass transistor is a readily available 2N3055 transistor, which is driven by a TT801, 2N3053 or similar TO-5 transistor of nominal 1W rating. Two 1W zener diodes, one a 10V type and the other a 15V are used to provide the reference. A 2000uF/25VW electro is used across the output of the supply to provide the peak current capacity, with a 2.7k/1W bleed resistor to improve regulation.

Although the peak current drawn by the printer solenoids is 6A, this simple circuit maintains the 24V line well within the allowed tolerance at all times. In fact peak-to-peak ripple when printing a line of "B" characters (a fairly severe test) is barely 1V, and for typical lines is only about half this figure.

The +13V supply is derived from the centre-tap of the transformer winding, which

Although the total power consumption of all four supplies connected to the power transformer in the power supply can be as high as 50VA when the printer is actually printing a line of characters, the fact that printing only occurs for about 45% of the total printer cycle means that average load on the transformer is well within its 40VA rating. This is so even if the printer is used continuously, so that the transformer runs quite cool. In fact the main reason for using the 40VA transformer is to obtain satisfactory regulation.

Note that the five rectifier diodes used in the power supply are specifed as A14 series devices. These devices are transient protected, and in view of their great ruggedness I recommend that you use them at least for the main rectifier bridge. Although the 100V rated A14A type is shown, the 50V A14Y could be used instead if available, or failing these the more readily available A14D (400V). The price of all three types is very little higher than regular plastic diodes.

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EDUC-8 computer

up the printer circuitry to the power supply is that the earth return of the 24V solenoid wiring should be run directly back from the AC64 PCB socket pin to the negative lug of the 2000uF electro. There are heavy current pulses flowing in this lead during printing, and if they are not kept out of the rest of the electronics, the voltage spikes caused by lead inductance can cause all sorts of misfunction. The separate earth return ensures that this does not occur.

The remaining earth pin on the AC64 board should be run to a common earth point, established where the earth braid of the computer IOT cable is terminated. The earth connection of the CC64 board should also be made to this point, which is then linked to the earth pins of the various interfacing ICs, and back to the earthy lugs of the two 2200uF filter capacitors in the power supply. The 5V supply line from the computer should be bypassed to this earth line with .047uF LV polyester capacitors upon termination from the cable, at the AC64 and CC64 supply pins, and also near the 74164 and 7437 devices.

No details will be given here for the mechanical side of the printer, as this will depend upon the way you want to package it. As there are only four ICs, two transistors, a small cradle relay and a handful of small parts in the interfacing logic, these can easily be mounted on a small PCB or square of Veroboard cut to match the CC64 and AC64 boards. The power supply wiring can be built up easily on a small length of miniature resistor panel, apart from the major parts.

Note that the CC64 and AC64 PC boards are designed to plug into 35-way edge connector sockets, having 0.1in connector spacing, and I suggest that you use sockets rather than solder direct to the boards, to avoid damage—they are not cheap. As the exact dimensions of sockets vary, it is best to obtain the matching Philips type F061 sockets (12-digit code 2422 048 13503); two will be needed.

Full connection details for the CC64 and AC64 boards is provided on leaflets supplied with them. Note that the CC64 is provided with outputs from the scanning counter and the oscillator, but these are not used here. The AC64 is also provided with duplicate output connections from the solenoid drivers—both as a row of pins of the top of the board, and as a group of pads on the edge connector. The latter are not used here, as the cable from the printer head is provided with a connector which mates with the row of pins.

The connections for the printer mechanism are clearly marked along the terminal board at the rear of the frame, and also on small connectors supplied "plugged on" to the various connector pins. The connection code is the same as used in Fig. 1, so that you should have no trouble in wiring this up.

Finally, a word about programming for the printer. Basically, the printer is handled in much the same manner as any other output device, the usual way being to service it via a subroutine which transfers the data word out to the device buffer from the AC register, resets the device flag, and then waits until the flag is set again.

The data words sent to the printer will be the codes for the particular characters to be printed, supplemented by the control bit—or bits, if you have wired the printer to respond to both.

If you have wired the printer according to Fig. 3 the basic character code will be as shown in Fig. 2, with the control bits normally both being set to zero. To make any desired character repeat until the end of a line, the code is simply modified by setting the most significant bit to 1—equivalent to adding octal 200.

EDUC-8 PROGRAM	"MESSAGE PRINTER" SA = ØØØ	
STEP	**MNEMONIC**	**CODE**
0	START,CLA	71Ø
1	TAD BFS /fetch start of buffer	117
2	DCA PTR /initialise pointer	316
3	CON,TAD I PTR /fetch char	136
4	SZA /terminate code?	73Ø
5	JMP .+2 /no, keep going	5Ø7
6	HLT /yes, stop	721
7	LPB } print sequence	626
10	SPF } print sequence	621
11	JMP .-1 } print sequence	51Ø
12	ISZ PTR /increment pointer	216
13	JMP CON /continue	5Ø3
14	HLT /end of buffer -- no term.	721
15	---	---
16	PTR,ØØØ	ØØØ
17	BFS,Ø2Ø	Ø2Ø
20	(first char to be printed)	
21	(second char)	
22	(third char)	
23	...	
24	...	

Fig 5: A simple program to print out text strings, from a buffer starting at location 020. Note that the instructions in 005 and 011 use a full point to represent the "current memory location"; this is a fairly common mnemonic convention.

If a program must print out an instruction to the operator, an explanation or some other string of text characters, this is normally done by storing the appropriate string of code numbers in sequence in the memory, as part of the program. The part of memory occupied by the text string is usually called the "text buffer". To print the text the program is provided with a small instruction loop, wherein an indirect TAD instruction using a "pointer" address is used to fetch the code numbers from the buffer locations one after the other, by incrementing the pointer address each time around the loop.

As the "at" symbol corresponding to octal code 00 is very rarely used in text strings, this can be used as a message terminate code. Thus the string of characters forming the message in the text buffer need only be followed by a 000, and the instruction loop used for the printing out arranged to jump out of the loop immediately it recognises that the number fetched from the buffer is zero. This allows the message itself to time the number of times the loop is traversed, and avoids the need to set a loop counter to different values for different length messages.

The simple program shown in Fig. 5 should help to illustrate these techniques. It is purely a program to print out a "pre-recorded message", and you can make it print out any message you like simply by depositing the appropriate character codes in the locations beginning at that with address 020. Note that if you do not end the desired message with a 000 terminate code, the program will continue to print out whatever random numbers are present in the rest of the memory, and will only stop when it has printed the contents of location 377.

This illustrates the very simplest type of programming for a printer, where the characters are simply stored and "played back". There are many other possibilities. For example the program which was used to print out the table of Fig. 2 used this technique for the text at the top of the table, but printed the table itself by using an index variable which was printed out to give the first character, then analysed to produce the codes for the equivalent octal digits, which were then printed out also—after printing 6 spaces. Then the index was incremented, and the process repeated to produce the second line. This was arranged to be repeated for a total of 64 times (77 octal), to print out all 64 characters and their octal codes.

Space prevents me from giving the program itself here, and in any case it would be a good exercise for you to try writing one yourself, knowing what has to be done and the general line of attack. Here's a clue, though: to print out a 3-bit binary number as the equivalent octal digit, all you need to do is add octal 60, to get the required code number.

Incidentally, in writing programs which involve the printer, don't worry too much about the fact that it needs to be fed with a stream of characters once a line printing cycle has been started. Even though EDUC-8 is not a particularly fast computer, it is still quite fast compared with the printer.

In fact the time interval available to the computer to generate and deliver a new character, after the printer flag has been set by the "demand new character" signal, is typically 6.25ms. This is equivalent to about 65 fetch-execute instruction cycles—so that there should normally be more than enough time for the computer to keep up. Unless you have a very complex program, it is more likely to be spending most of its time waiting on the printer!

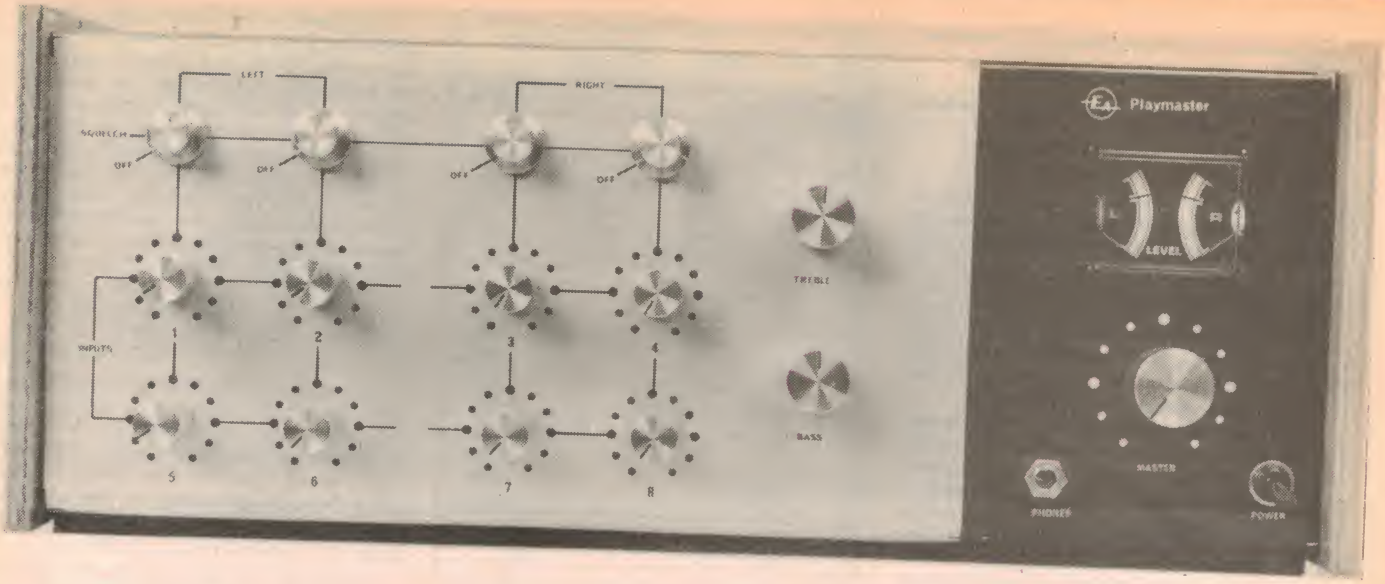
I hope the discussion given here of the Philips 60SR printer and its operation with the EDUC-8 microcomputer is of interest to you. While only a small printer, it makes a very worthwhile addition to the overall EDUC-8 system, and illustrates very well the way in which larger printers are used.

PLEASE NOTE

Further testing of the interfacing logic given for the Welmec paper tape punch, in the last section, has revealed that malfunction can occur during fast repetitive punching, due to a timing problem.

Because RLY A, used to generate the "end of cycle" flag setting signal, is driven from the top contact of the bistable switch contacts, it can reset the flag slightly before the cycle has actually ended. If the computer immediately loads in a new character and resets the flag (still before the cycle has actually ended), the punch will ignore the new character. At the same time the computer program continues to wait for the punch to set its flag, to indicate that it has punched the character. Thus the system "hangs up".

There are a number of ways in which this can be prevented, but the neatest and most effective way is to simply slow the operation of RLY A down, using an R-C circuit between the top contact of the bistable switch and the +120V supply line (in parallel with the existing spark suppressor capacitor). I found that a 4.7uF/150V electrolytic in series with a 220 ohm 1W resistor did the job very well.



PLAYMASTER 145

. . . our new eight input stereo/mono mixer

Our final article on the Playmaster mixer discusses assembly of the preamplifier and mute boards and gives details of the complete chassis assembly.

by LEO SIMPSON—PART 3

After assembly of the mixer and mother boards is complete, attention can be turned to the preamplifier and mute boards.

To enable PC board manufacturers to make the small preamplifier and mute boards available economically, we have prepared the artwork transparencies in groups of eight and four respectively. Hence, when the prospective constructor purchases these boards, he will most likely be supplied with a board containing one or two strips which have to be cut into four sections.

Guidelines are provided on the copper patterns to facilitate cutting the strip boards into individual sections. This can easily be done by clamping the strip between two pieces of timber in a vice and cutting with a fine-tooth hacksaw. Take it easy when cutting, otherwise you may crack the board.

Both the preamplifier and mute boards should be supplied with gold-plating or gold-flashing on the connector contacts, otherwise contact-resistance will be a problem.

A keyway must be cut in each of the plug-in PC boards to polarise them and so prevent them from being plugged in to the edge connector incorrectly. This is arranged by cutting along the length of the connector contact nearest the input capacitor, using a hacksaw.

Ensure that all boards plug in easily without fouling of the keyway, before mounting any components or soldering.

No problems should be encountered with assembly of the plug-in boards. If constructors are not able to obtain PC mounting 220uF capacitors, C1 can most easily be mounted by interchanging its position with R2 (where C1 is required). On the mute board, the 4.7uF capacitor in series with Tr14 should be a tantalum type. The other 4.7uF capacitor associated with the output from Tr13 may be either a tantalum or PC mounting aluminium electrolytic.

Since the circuit of the ceramic cartridge is quite different from the universal preamplifier circuit, the standard board pattern has to be modified to accommodate it. The wiring diagram of the ceramic preamplifier board shows where the copper pattern is cut and the position of the wire links-three on the topside and two on the copper side of the board.

Having assembled and carefully soldered all the PC boards, attention may be turned to the chassis. Mount the four rubber feet first. Then carefully follow the details given in the following paragraphs for mounting the transformer and associated hardware.

One of the problems we had to contend with early in the development of the Playmaster mixer was the possibility of earth loops, when the mixer was connected to a tape recorder or power amplifier that was itself earthed back via the mains wiring. The problem is compounded because even the very low level input sockets are earthed directly to the chassis.

After discussion of the matter with an officer of the Electrical Safety section of the Electricity Authority of NSW we were recommended to follow this procedure:

(1) Use a two-section bobbin-wound transformer conforming to the insulation and winding construction requirements of Australian Standard C126.

(2) Do not earth the chassis of the mixer back via the mains cord. Instead, mount the transformer on two insulating pillars. In the unlikely event that the transformer insulation does break down to the core, no hazard would result.

(3) Sheath the active leads from the on/off switch with suitable plastic sleeving.

(4) Use an on/off switch of all plastic construction, such as the McMurdo 475 series toggle type, and sleeve the spade lugs of the switch to prevent accidental contact of the user with the mains.

Hence, we used the Ferguson PF 3786 transformer which satisfies the above requirements. It was mounted on two Ebonite spacers tapped for ⅛in Whitworth screws. Nylon spacers could be used as an alternative.

In spite of abovementioned suggestion

(2), we found it necessary to earth the core of the transformer back to the mains cord earth, in order to reduce the induced hum in the low level preamplifiers, particularly those for the magnetic cartridge.

Twist the two wires from the terminal block to the on/off switch and sleeve them—the outer sleeve of the mains cord will be quite suitable. Before soldering the wires to the switch, push a length of suitable sleeving over the wires and after soldering, push the sleeving over the spade terminals of the switch. All three terminals of the switch should be sleeved.

Ideally, the transformer should have a wraparound cover for the mains primary connections. The cover should be made of Presspahn or Elephantide (trade names for a vulcanised insulation material used in transformer and electrical motor construction). Unfortunately, we were unable to obtain a supply of this material during construction so we had to be content with wrapping two layers of insulation tape around the transformer to cover the terminations, after soldering short leads to them.

Note that ordinary cardboard is not suitable for the job, as it is hygroscopic.

Before actually mounting the transformer on the insulating pillars, mount the six-way terminal block and terminate the transformer primary and secondary leads to it. Connect the red and blue secondary leads together to form the centre-tap of the series connected windings.

The mains cord should be passed through a grommetted hole in the rear of the chassis and anchored with a cord clamp. Terminate the mains active and neutral leads to the terminal block and solder the earth wire to a solder lug to be secured under one of the transformer mounting feet screws.

Make sure that two screws in each insulating spacer do not touch in the centre and thus negate the intended isolation of the transformer core. In other words, use screws of a suitable length and check with a multimeter to ensure that the transformer core is actually isolated from the chassis yet is in good electrical contact with the earth wire of the mains cord.

Those in the market for microphones would be hard put to pick better units for public address or tape recording than this pair from Shure. Above right is the omnidirectional "Versadyne" 575SB while to the left is the unidirectional (cardiod pattern) 515SA.

Both models have a built-in slide-to-talk switch to control the microphone circuit. The 515SA is available as a high impedance model while the 575SB is suitable for use with tape recorders having low impedance (200 ohms) mic sockets.

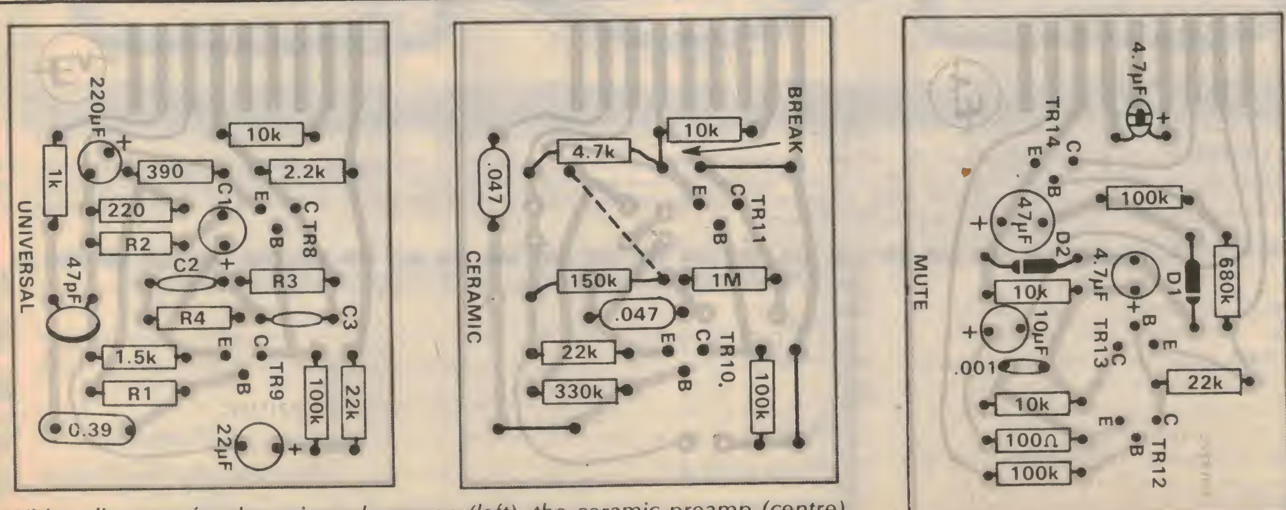
Rugged construction to withstand rough usage is a feature of both microphones which is another plus point for public address use.

Further information on prices, performance accessories can be obtained from the Australian distributors for Shure Microphones, Audio Engineers Pty Ltd, 342 Kent Street, Sydney, N.S.W. 2000.

The headphone socket must also be isolated from the chassis and be provided with an earth return lead back to the mixer board. Otherwise, the headphone earth return current flows in the chassis and back via the earth paths for the input signals. This causes instability when the low impedance microphone preamplifiers are used.

Wrap the threaded bush of the headphone socket with insulating tape or a suitable piece of plastic sleeve. Use a fibre washer on both sides of the front panel and check with a multimeter to see that the socket is correctly isolated from chassis.

The dual meter is a rather attractive unit kindly supplied by Paris Radio. It has blue-tinted scales (but not calibrations) with red pointers. It is intended to be illuminated by a light shining through the translucent rear section. At the same time, mounting of the meter presents



Wiring diagrams for the universal preamp (left), the ceramic preamp (centre), and the mute board (right). All boards are shown actual size.

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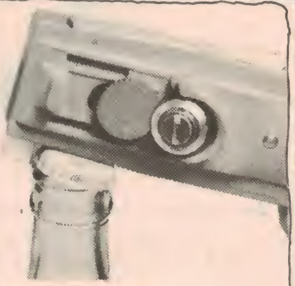

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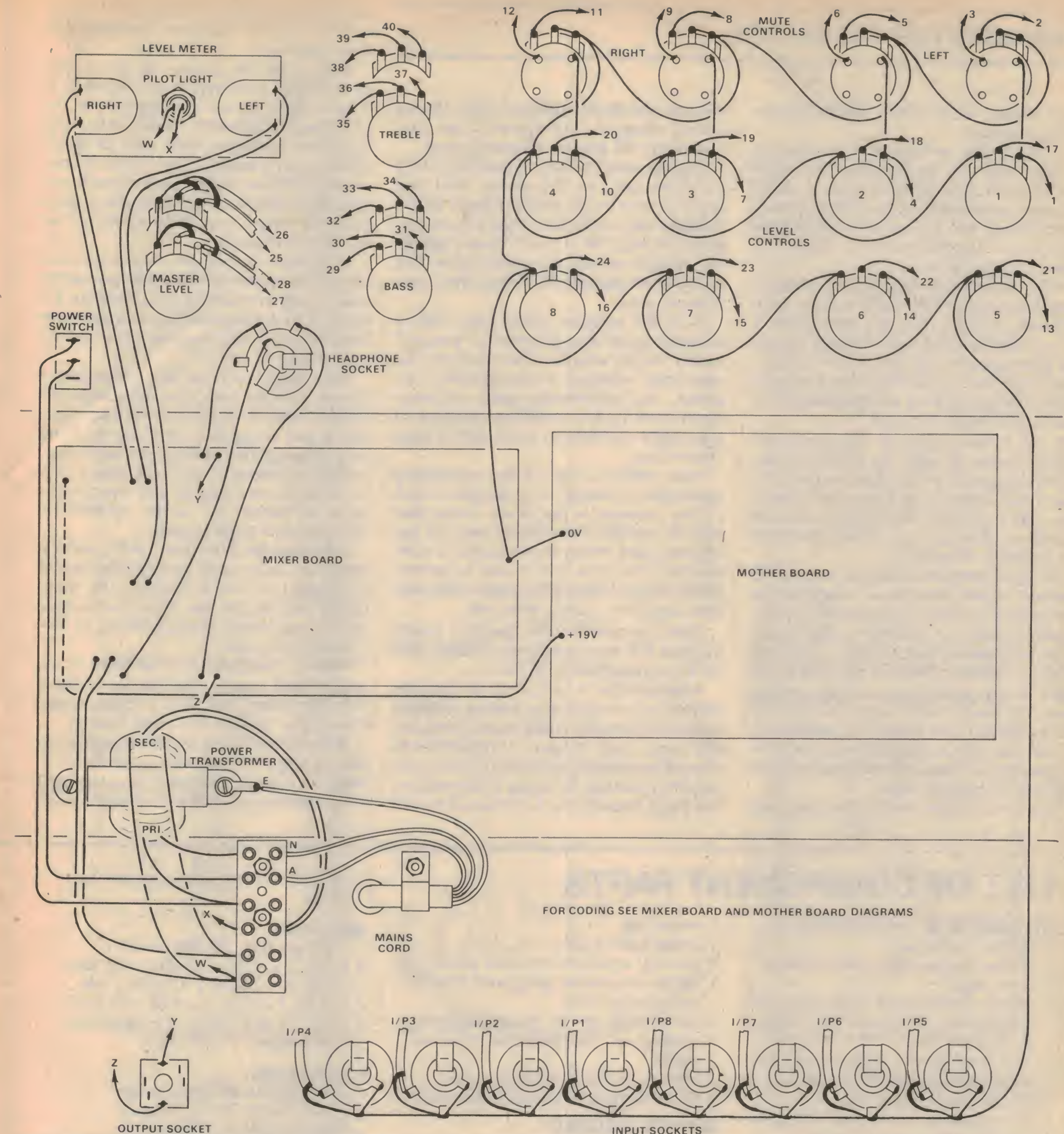


The wiring diagram for the Playmaster 145 Mixer. Follow this diagram in conjunction with the circuit and the photographs.

problems as there are no screws or lugs of any sort provided.

Our approach was to make up a bracket which holds the meter in place and also positions a small lamp in the correct position for lighting. The bracket itself is held in position by the master level control dual potentiometer.

Parts suppliers may obtain the dual meters from Paris Radio, 7a Burton Street, Darlinghurst, NSW, 2010.

Illumination is provided by a Sato miniature bezel with the red lens removed. A 12V lamp is fitted, which draws about 100mA from one of the 14V windings of the transformer, and the regulation is such that only 12V is applied to the lamp. When combined with the 60mA DC drawn by the mixer circuitry, the total load is excess of the nominal transformer rating, which is 2 x 14V at 60mA.

Discussion with an engineer at Ferguson Transformers Pty Ltd revealed that the rating was determined mainly by the regulation of the transformer and not by the heat dissipation in the windings. In short, while the transformer is running in excess of its ratings, it does not represent a situation of undue stress.

After an extended period of running, the transformer was found to be warm to the touch, but not unduly so.

Before the master level control potentiometer is mounted to secure the meter bracket in place, cut the shaft to 13mm length and solder the figure-8 shielded cable to it. Two lengths of 200mm of figure-8 shielded cable will be adequate.

All the potentiometers should have

their shafts cut to 13mm length before being installed.

All the input sockets and the output sockets may now be installed. The input sockets have a shorting contact to earth the input when not in use. All the chassis connections for the input sockets are connected together with a length of tinned copper wire.

Now install the mixer and mother boards. Use ⅛in Whitworth screws, nuts and lock-washers. An easy alternative is to use Richco PC board mounts (these are illustrated in the Dick Smith Catalogue). Eight Richco CBS-6N board mounts will be required. They are distributed by Warburton Franki Pty Ltd.

If the Richco supports are used, the chassis holes to take them should be 4.5mm diameter (or 3/16in) and the PC board holes should be 4mm (or 9/64in). The advantage of using the Richco mounts is that you can easily demount the board if necessary.

All interconnections to the mixer and mother boards should be made using pieces of flat multiconductor cable (otherwise known as "rainbow" cable) apart from the shielded input cables. Using the rainbow cable obviates the need for cable lacing and makes circuit tracing easy. We found two metres of 10-conductor cable to be more than adequate. As a bonus it gives a wide range of wire colours and is cheaper than an equivalent quantity of hookup wire.

Take care to wire the boards, pots and sockets exactly as indicated in the chassis wiring diagram. Otherwise, hum and instability will almost certainly result.

Having checked all connections, fit a three-pin plug to the mains cord and apply power to the mixer. Check all the voltages shown on the mixer circuit diagram on page 44 of the February article. All voltages should be within 1V or 10% of those on the circuit. If not, check the components.

If all the voltages check out, now is an appropriate time to make a "jumper" board which enables the mixer to be operated without a preamplifier, ie, direct. You will need a piece of Veroboard with 0.15in conductor spacing, at least eight conductors wide and at least 30mm long.

Now refer to one of the assembled preamplifier boards and identify which of the contacts is the input connection (this is actually the contact next to the keyway) and which is the output 2 connection. The idea is to make a dummy board which bridges the above two contacts together, with a wire link.

With the jumper (or dummy) board in place, the input sensitivity is 40mV with an input impedance of 5k.

Alternatively, if you wish to provide higher input impedance and/or reduced sensitivity than the mixer board provides, the input and output 2 connections should be connected by a suitable resistor. For example, by using a 22k resistor, the input impedance is increased to 27k and the sensitivity is reduced to 216mV which would be adequate for most high level sources.

Now, with the jumper board in one of the edge connectors for inputs 5, 6, 7 or 8 (refer to the photograph of the front panel to identify these), check out the mixer operation with a set of headphones and a suitable signal source connected. With no signal applied, the mixer should be almost completely silent, even with all level and tone controls at maximum settings.

Note that the jumper board will not allow the mixer to function correctly when used in place of preamplifiers for inputs 1 to 4, unless the associated mute board is in position and the mute control is switched to off.

Now plug each of the preamplifier boards, one at a time, into an appropriate edge connector on the mother board and check the voltages on the circuit. Now plug preamplifier boards into edge connectors for inputs 1 to 4 and plug in the associated mute boards and check voltages on these (ie, at the emitter of TR11 on each mute board).

Note that the mute board will not work unless an associated preamplifier board is plugged in. This is because the mute board obtains its bias from the output of the preceding preamplifiers, as explained previously.

With a microphone connected to an appropriate input, you can now check that the mute function is operational. Check this with all the mute boards.

When all checking and de-bugging has been completed, you can install the front panel. It is better to leave this step until now, otherwise there is a strong chance

LIST OF COMPONENT PARTS

CHASSIS & HARDWARE

1 chassis with cover
2 timber end panels, 205 x 165mm
1 front panel
1 power transformer with two 14V secondaries, Ferguson PF 3786 or equivalent
1 dual level meter, 500uA sensitivity (as distributed by Paris Radio)
1 meter bracket (see text)
1 Såto miniature bezel with 12V lamp
15 knobs; select types to suit
1 10k (log) dual ganged potentiometer
2 100k (lin) dual ganged potentiometers
8 10k (log) potentiometers
4 1k (lin or log) potentiometers with switch
2 6.5m stereo jack sockets
8 6.5mm jack sockets with shorting contacts
1 McMurdo series 475 all-insulated toggle switch
2 12mm insulating spacers, tapped ⅛in Whitworth
1 solder lug
1 mains cord clamp
1 six-way insulated terminal block
1 three-pin mains plug and three-core mains cord
8 Richco CBS-6N PC board supports
2 meters of 10-conductor rainbow cable
2 meters of figure-8 shield cable
2 fibre-washers for headphone socket

MIXER BOARD

1 printed board, 74mx12b
37 PC stakes

SEMICONDUCTORS

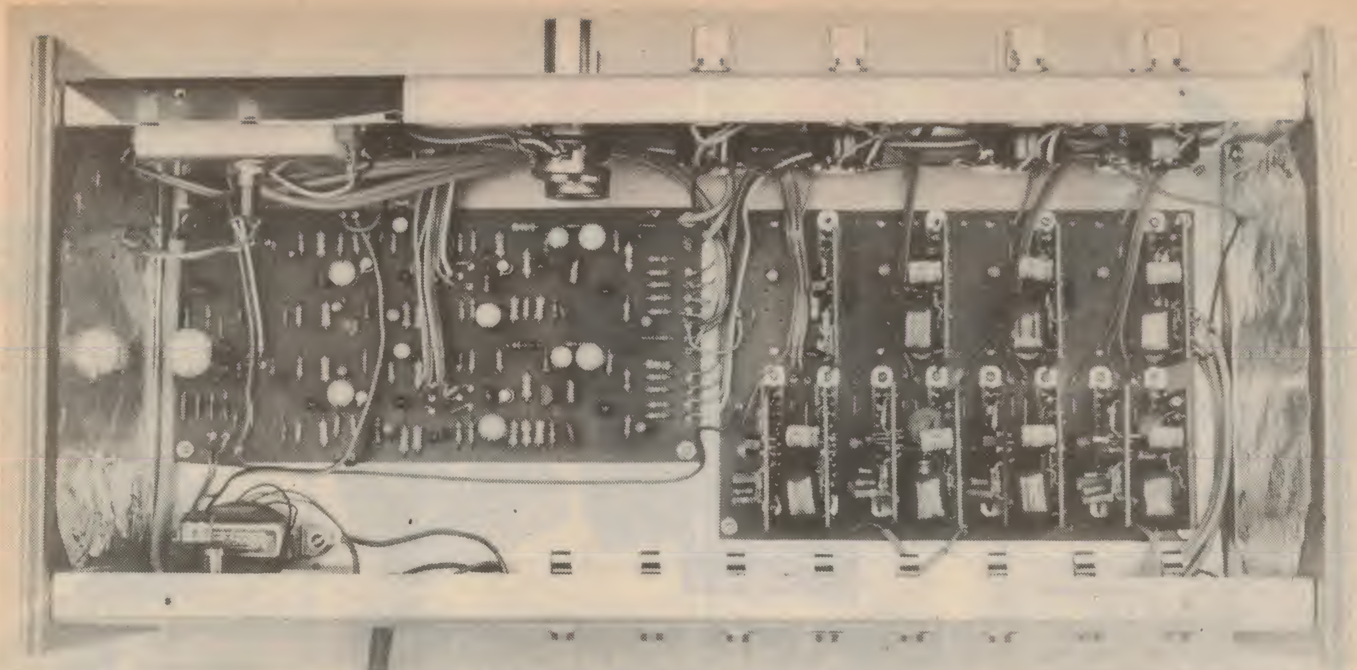
4 EM401, BY126/100 silicon rectifier diodes
8 1N4148, 1N914A silicon signal diodes
1 x BZX79/C20 zener diode
4 BC109, BC549, BC184L low noise NPN silicon transistors
6 BC108, BC548, BC183L silicon NPN transistors
2 BC107, BC547, BC182L silicon NPN transistors
1 BD137, TIP31A silicon power transistor

RESISTORS

(¼W or ½W, 5% tolerance)
4 x 1M, 2 x 220k, 2 x 150k, 4 x 100k
2 x 82k, 4 x 22k, 4 x 15k, 26 x 10k
2 x 4.7k, 5 x 2.2k, 2 x 1.8k, 2 x 1.5k
8 x 1k, 2 x 820 ohms, 2 x 390 ohms
2 x 270 ohms, 1 x 47 ohms

CAPACITORS

1 470uF 63VW PC electrolytic
2 220uF 10VW PC electrolytic
2 100uF 25VW PC electrolytic
2 47uF 25VW PC electrolytic
2 22uF 25VW PC electrolytic
2 10uF 25VW PC electrolytic
4 4.7uF 25VW PC or tantalum electrolytic
2 1uF 25VW PC or tantalum electrolytic
6 1 uF 25VW tantalum electrolytic
2 0.22uF 100VW metallised polyester or polycarbonate
2 0.1uF 100VW metallised polyester or polycarbonate
2 .047uF 100VW metallised polyester
4 .0015 100VW metallised polyester



This view shows the complete chassis assembly with all modules in position.

of scratching the panel while fiddling about.

Scotchcal was used to make the front panel of the prototype mixer. The panel was made in two parts, with the join being concealed by a piece of pressure-sensitive tape. We assume that metal-work suppliers will have front panels available shortly after this article is published.

Fifteen knobs are used in all. As can be seen from the photographs, we have used several different types of knob, each selected to suit the control function. It is desirable to have the individual mixer level controls small while the main level control knob can be fairly large.

On the prototype, the timber end panels were attached by screws from inside the chassis, but this is a very awkward method. A better procedure would be to have recessed holes in each panel and attach them by self-tapping screws to the chassis, from the outside. Before mounting the panels, staple a sheet of aluminium foil (as used for cooking) and position it on the panel so that it will make contact with the chassis and so provide a degree of shielding.

The top panel can be given a practical finish by covering it with vinyl, using contact adhesive.

For best results, do not stack the mixer on top of power amplifiers with large transformers, otherwise hum will be a problem. Power amplifiers need plenty of ventilation anyway. At the same time, keep low level input leads away from power transformer fields.

2 47pF 125VW ceramic or polystyrene.

MOTHER BOARD

1 printed board, 74mx12d
26 PC stakes
12 edge connectors, eight-way with one open and one closed bracket, McMurdo part number 1333-11-17
4 4.7uF 25VW tantalum electrolytic capacitors
4 .047uF 125VW ceramic capacitors
24 poprivets and washers or screws, nuts and washers to mount edge connectors.

PREAMP BOARDS (8)

1 printed board, 74mx12a, with gold flashed or tin plated edge contacts
2 BC109, BC549, BC184L low noise silicon NPN transistors

RESISTORS

(¼W or ½W, 5% tolerance)
1 x 100k, 1 x 22k, 1 x 10k, 1 x 2.2k, 1 x 1.5k 1 x 1k, 1 x 390 ohms, 1 x 220 ohms.

CAPACITORS

1 220uF 10VW PC electrolytic
1 22uF VW PC electrolytic
1 0.39uF 100VW metallised polyester or polycarbonate
1 47pF 125VW ceramic or polystyrene.
Plus R1, R2, R3, R4, C1, C2 and C3 as required.

MUTE BOARDS (4)

1 printed board, 74mx12c
1 BC 148, BC548, BC183L silicon NPN transistor
1 BC158, BC558, BC213L silicon PNP transistor
1 BC149, BC549, BC184L silicon high-gain NPN transistor
2 1N4148, 1N914A silicon signal diodes
1 680k, 2 x 100k, 1 x 22k
2 10k, 1 x 100 ohms (¼W or ½W 5% tolerance resistors)
1 47uF 10VW PC electrolytic
1 10uF 6VW PC electrolytic
1 4.7uF 25VW PC or tantalum electrolytic
1 4.7uF 25VW tantalum electrolytic
1 .001uF 100VW metallised polyester or polystyrene capacitor.

CERAMIC PREAMPLIFIER

(Optional: 2 required)
1 printed board, 74mx12a
2 BC109, BC549, BC184L low noise silicon NPN transistors
2 .047uF 100VW ceramic or metallised polyester capacitors
1 x 1m, 1 x 150k, 1 x 100k, 1 x 22k, 1 x 10k, 1 x 4.7k (¼W or ½W, 5% tolerance resistors).

MISCELLANEOUS

Tinned copper wire, electrical insulation tape, spaghetti sleeving, vinyl covering material, contact adhesive, self-tapping screws, solder.
Note: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used, provided they are physically compatible. Components with lower ratings may also be used, provided ratings are not exceeded.

KITSETS

KIT'S KOLUMN

Well, it's happened. Expense-Account has finally flipped his lid. You never saw such megalomania. I got the usual summons to grace the inner sanctum. There was this wild gleam in his eyes, and Monopoly money all over the desk.
On which he was standing.
"Today—Australia!" he screeched, "tomorrow—the **world!**"
"That's nice," I replied.
"How's your Kitsch collection?"
"I don't pay you to be facetious to **me!**" he snorted, stomping his left gumboot into his new calculator which expired with a sparkling shower of LED's. "Now, lissen to this, my little chicken . . . . . "
An hour later I still couldn't believe what I'd heard. And in the coming months it should stagger you, too.
BIG things are happening at Kitsets. And I think that maybe Expense-Account could be right about the world bit . . .

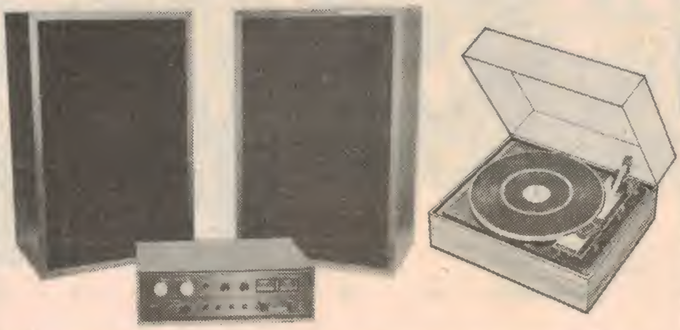
Just to get the ball rolling, we're lopping up to **Thirty per cent** off all component parts for personal shoppers during April. Offer lasts as long as stocks do. Even Alfred E. is welcome. (Where **did** he get that haircut?)

Elsewhere in this extravaganza you'll find the first of our monthly specials for personal shoppers. Only a few at each store, so be quick. NOBODY can get within cooee of our cut-throat price on these.

Last month in our top secret report on the operations of Mom we promised to tell you how to convert a 5 cell flashlight into a 2-cell. That'll be in next month's Kolumn. Meantime, keep your letters coming. Just address them to me (Kit) at our Dee Why Box number, and . . . . . .

Keep your iron hot,

Kit

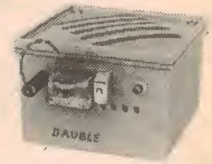


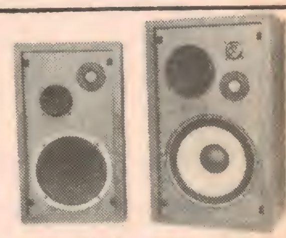
COMPLETE HI-FI SYSTEM: A BEAUTY FOR ONLY $299

Not a kit, nothing to build. Just hook all units up, plug in, and you're in business. System consists of the Phodis C6000 amp which puts out 20W per channel RMS, has twin VU meters, 6 input jacks, 2 output jacks, and more features than we can list here, PLUS the BSR P128 turntable which has diecast platter and is fitted with a Shure M75 cartridge. Your choice of speakers—our 8"• -way ready-made system or our kit with 12" twin cone and 1" dome speaker in each enclosure, which are both pre-assembled and veneered.
P&P $7

DON'T WARBLE-DAUBLE: KIT

9-tone door "chime" guaranteed to confuse the Avon lady. J. Pittar's 2nd prizewinner in the Kitsets-Electronics Australia competition. Peals a pre-set number of times then switches off at end of sequence. Be first in your street with one. P&P $1.50.
$22





STEINTRON AGAIN!

Our direct import—back again at last. Beautiful timber cabinets with louvred fronts. Absolutely superb performance.
V120: 12" woofer; 6½" middie; 1½ dome tweeter; 2" super tweeter. Crossover rolloff 12dB per octave; handles 45W RMS; 20-22000Hz. Has tone control. 25½" x 15" x 11½". P&P each $5. Price each **$112.**
V100: 10" woofer; 5" middle; 1½" dome tweeter. Handles 35W RMS, 20-20,000Hz. 22½" x 13" x 11½". P&P each $5. Price each **$89.**

BD1 BELT DRIVE MANUAL TURNTABLE COMPLETE AT $129

This is the famous "Connoisseur" unit as used by professionals. Unique flexible belt drive virtually eliminates vibration. (Rumble -60dB; hum -80dB; wow & flutter less than 0.1%). Comes complete as shown fitted in base with hinged acrylic cover. Also supplied: "Connoisseur" SAU2 precision pick-up arm, PLUS the superb VF3200/6 "Micro" variable flux stereo cartridge. All internal mounting hardware and cords supplied together with illustrated instructions. P&P $3.50.

APRIL SPECIAL!

As mentioned in Kit's Kolumn. Soldering irons, 240V 25W Weller SP25D. 1 1/3 oz, 8¼" long, 1/8" screw-in replaceable tip never needs filing. Stainless steel barrel. Plug fitted. Suggested retail $12.50. Our whacky April price . . . **$7.95** Small quantity each store, personal shoppers **only.**

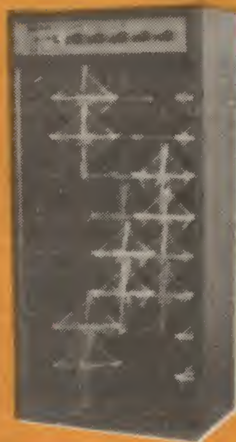
THE ULTIMATE ELECTRONIC ALARM CLOCK KIT: $82

Not one of those half-baked thirty buck jobs. This is the superb EA design (Dec. '74) with 24-hour indication, integral snooze facility, sleep facility for turning off a radio or similar, and automatic variable intensity display. When we say "nothing missing" we mean it — out kit includes **everything** to build the finished product. Full instructions, with diagrams. Not recommended for rank beginners. We rate this as one of the most exciting projects we ve yet seen. P&P is $2.

SYDNEY: 400 Kent St. Sydney, 29 1005. 657 Pittwater Rd., Dee Why. 982 9790. **ADELAIDE:** 12 Peel St. Adelaide, 87 5505. **BRISBANE:** 293 St. Paul's Tce. Fortitude Valley, 52 8391. **MELBOURNE:** 271 Bridge Rd. Richmond (Gallery Level, Church St. entrance) 42 4651. **PERTH:** 557 Wellington St. Perth (Opp. new bus terminal), 21 3047.

$3.38 OFF VALVE SET
Check our catalogue. To buy the three most popular valves (IS2/6AL3/6CM5) would normally cost you $6.88. Well, for orders postmarked April (or for personal shoppers) we've zapped the price for the set of 3 down to **$3.50!** P&P is 60c. Only 1 set per customer. Hurry before our accountant finds out.

SEE WHAT COLOUR YOUR MUSIC IS

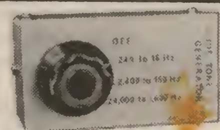


NOT a kit. These are the spectacular SECO colour organs. Connect to any speaker and the colour lamps flicker and glow with varying brightness in relation to volume, pitch, and rhythm. Why put up with colour TV? Works even with small transistor radios. Leaves fibre-optic lamps for dead. **V3050:** Domestic unit. 30 lamps, 3 channels, 5 colours. Diamond pattern. 18½" x 11½" x 7 3/8". 3.5kg. P&P $2. **$49·50**

4050X: Professional monster. 32 lamps, 4 channels, 4 colours, individual colour mixing controls and a host of other features. Ideal groups. About 30½" x 15½" x 9 1/8". P&P $3. **$84**

WANNA BE FAMOUS?

You too, can be the adored idol of thousands of Kitsets customers and project freaks. OK then, maybe not exactly famous, but at the very least you'll have your name in our ads . . . and money in your pocket. We're working on a beaut plan that revolves around your own project ideas. More details next month.

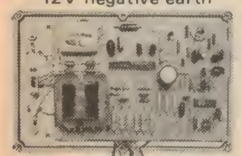


$8·50

GLIDE-TONE GENERATOR

Rod Torkington's 3rd prizewinner in the Kitsets-Electronics Australia competition. Simple to build. Checks loudspeaker response by logarithmic sweep down musical scale. P&P $1.

12V negative earth



ELECTRONIC TACHO. IGNITION, & REV LIMITER KIT

Overcomes serious failings of lesser types, gives same benefits like extra long point and plug life, **plus** handy protection against over-rev blow-ups. Kit complete with instructions and diagrams, the critical recommended capacitors (no makeshift substitutes) all screws, nuts, plugs, sockets and so on as well as the required meter for tacho operation. **$53·50** P&P $2.50.

NEW SQ DECODER KIT

Build this new 3 IC SQ decoder—incorporating both full logic and wave-matching. Connected between the tape out and tape in on your existing amplifier, and connected to a rear channel stereo amplifier it provides you with a fully decoded SQ sound. Our kit comes complete with all parts, including power supply, and a case about 8" x 2½" x 5½" plus sleek blackface front panel. P&P $2.50

$59·50

5 STAGE LOGIC PROBE

This is the 1st prizewinner in the Kitsets-Electronics Australia competition. Designed by Ian Robertson, it's an elegant unit, and easy to build, has 7-segment readout. If you're working with logic circuits, it's one kit you should build. P&P $1. **$13.**

$65 COMPUTER

Not just an arithmetical calculator but a professional scientific tool:
You will be asked to pay $100 and more for similar instruments.
The Hornet SR30 is an algebraic-mode, 8-digit unit with the normal +, −, X and ÷ functions plus Memory with 4 operations (M+, MR, X−M, CM) and 6 command functions (+/−, F, DR, X−Y, rad/deg, CL).
12 scientific functions
These are 1/X, ex, ln, log, sin-1, cos-1, tan-1, sin, cos, tan √x, and xy. Trig and log functions are calculated to 6 dec. places.
The unit comes complete with batteries (4 penlight cells) and handbook. A socket is fitted for external DC power.
Supply is limited, and orders will be filled in strict rotation. Price includes registered post and packing cost.
Note: This unit has a blue fluorescent display.

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JM 2164 DPS

What's new in Solid State

525-line video from CCD imager

Perhaps the most intriguing development to report this month is the announcement by RCA that they have produced a new solid-state TV imaging array which is directly capable of producing a normal 525-line monochrome picture.

There have been quite a few imaging arrays produced over the last few years, of course, and many have been announced with a loud fanfare. But until now, when you read the fine print it turned out that the device concerned was only capable of quite modest definition—well short of normal TV standards.

The new RCA device appears to be the first to break the definition barrier. Dubbed "big SID", the device uses charge-coupled (CCD) technology, and has an array of 512 x 320 photo-elements—163,840 in all. Overall size of the device is 19 x 30mm, very much smaller than the smallest vidicon tubes.

A video preamp is included on the chip, along with the actual array. When clocked with 6MHz signals, the preamp output is normal 525-line video with a bandwidth of 3MHz.

The device offers low power consumption, no lag, anti-blooming characteristics, sensitivity and spectral response like a silicon-target vidicon, and above all the small size, ruggedness and freedom from microphony offered by a solid-state device.

Type number of the first device is SID51232, and RCA are apparently selling it both as a chip and in a complete solid state TV camera. Either way, it won't be cheap, but then breakthrough devices seldom are. For those who need the advantages right now, the cost probably won't be a drawback. The rest of us will have to wait until lower-priced versions turn up, in perhaps a year or two.

Coming back to more mundane devices, and those which you'll actually be able to buy here and now, one of the new releases from Hewlett-Packard is a voltage sensing LED with very sharply defined threshold.

Designated the type 5082-4732, the new device has been designed for use in cameras, radios, appliances, test instruments and other battery-operated equipment as a built-in battery condition indicator. It snaps on sharply at a nominal 2.5V, plus or minus 2.5mV. An external diode, zener or resistor divider may be used to extend the threshold to any desired level.

Packaged in a standard T-1 plastic case, the device looks just like any other LED. However it has an IC chip on the header along with the Gallium Arsenide Phosphide LED chip, as you can see from the artist's sketch. The device is temperature compensated, and its threshold varies by only −1mV per degree C, typical.

Above is the H-P voltage sensing LED; at right the SAK140 tacho circuit.

Other suggested applications for the 5082-4732 include logic level indicators, VU meters, and any similar application where precise voltage level indication is required.

Only the 1000-off price of 62 cents is quoted by H-P in their release, but further details on price and availability would be available in each state.

Also just released by H-P are a new family of high-efficiency seven segment numeric LED displays, designated the 5082-7600 series. These offer an increased digit size—11mm high—together with a choice of three different colours: red, yellow and green.

The new devices offer substantially increased efficiency—roughly 5 times that of previously available types. At the usual operating current level of 20mA per segment, luminous intensity per segment is 1720 microcandelas. Alternatively they may be run at current levels as low as 3mA per segment, with usable light output.

Peak segment current for multiplex operation is 60mA.

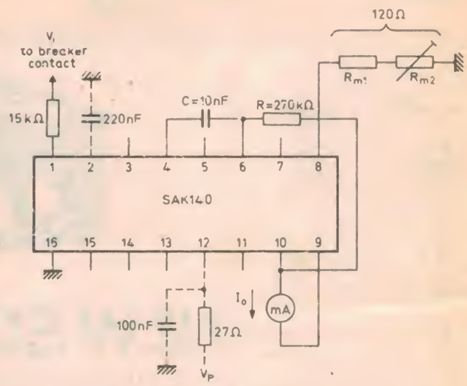
The devices use a lead frame in a standard DIL package. Single LED chips are used for each segment, with light pipes built in to the package to produce uniform segment illumination. Prices are $3.56 in 100-off quantities.

Two new ICs from Philips may also be of interest. One is a microphone preamp, designed to go with a low-impedance dynamic mike insert to form a replacement for a carbon mike, in telephones, mobile radio transmitters, and similar applications. The device is designated as the TCA980.

The device is rather unique, in that the internal circuitry will operate with either DC supply polarity. This is presumably so that it can be used to replace carbon mike inserts, regardless of the circuit and polarising supply arrangements.

Used with a dynamic mike insert having an impedance of 200 ohms and an output of 100uV/ubar, the TCA980 produces an output of 22mV/ubar across a load of 300 ohms. Noise output is 1.3mV RMS. The only external components required are the dynamic mike insert and a 0.22uF input coupling capacitor. The device is in a 4-pin TO12 transistor case.

The other device from Philips is designed for use in cars, as the heart of a tachometer. Designated type SAK140, it contains virtually all of the circuitry necessary to drive a meter movement from the breaker contacts.



The SAK140 comes in a 16-pin DIL package and is designed to work from a supply voltage between 10 and 18V. It has in-built supply regulation, as well as protection against reverse polarity. It will work with almost any meter movement up to 10mA FSD, and may be calibrated to any desired rpm figure, for any type of engine.

The external parts required are very few, and comprise four resistors, the meter movement, the timing capacitor, two bypasses and the calibrate pot. An additional diode may be added to improve temperature stability as a function of supply voltage.

No prices are quoted for either the TCA980 or the SAK140, but further information would no doubt be available from Philips Elcoma or their distributors. (J.R.)

For further data on devices mentioned above, write on company letterhead to the firms or agent quoted. But devices should be obtained or ordered through your usual parts stockist.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Top quality 5", 5 watt, for rear shelf or door. 12ft. of lead each. Super special price! 500 to clear.
Balance controls for two car speakers
137 Mono $3.25
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Precision worked in thin optical plastic and providing large area magnification equivalent to expensive glass lenses. Fine optical quality permits use as solar furnace elements, condensers, image magnifiers, light intensifiers, overhead and back projection optics, camera image brighteners (disco scenes). Use our low RPM geared motors to drive these. 8oz.
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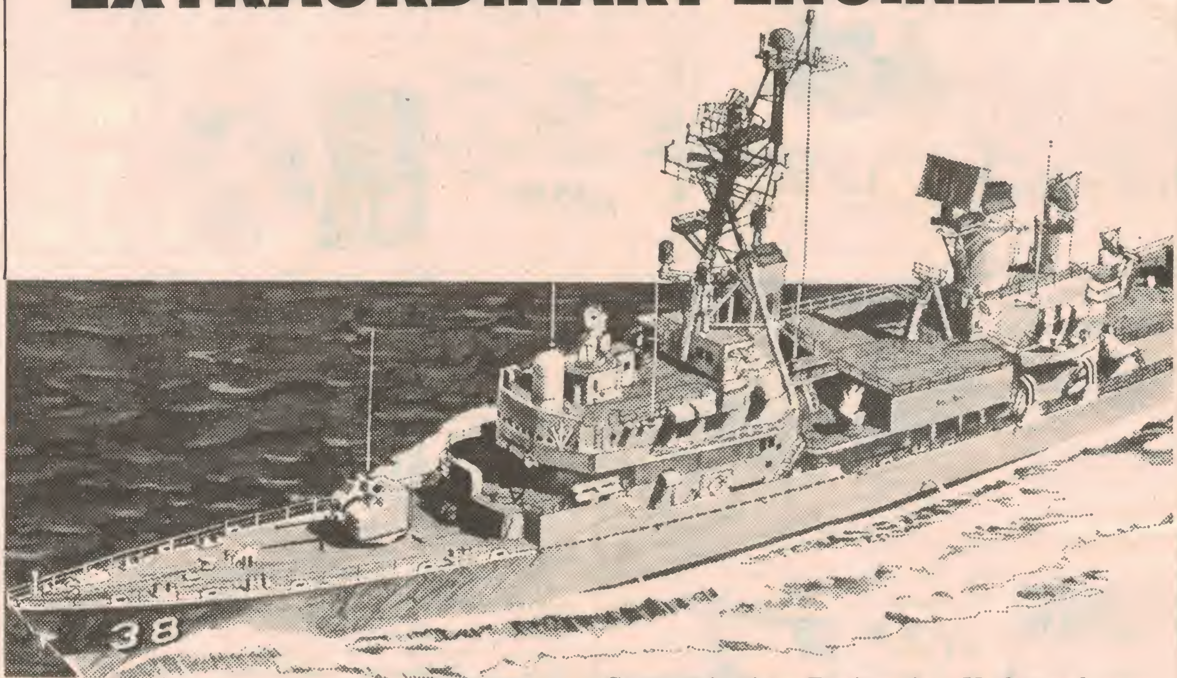

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Circuit & Design Ideas

Conducted by Ian Pogson

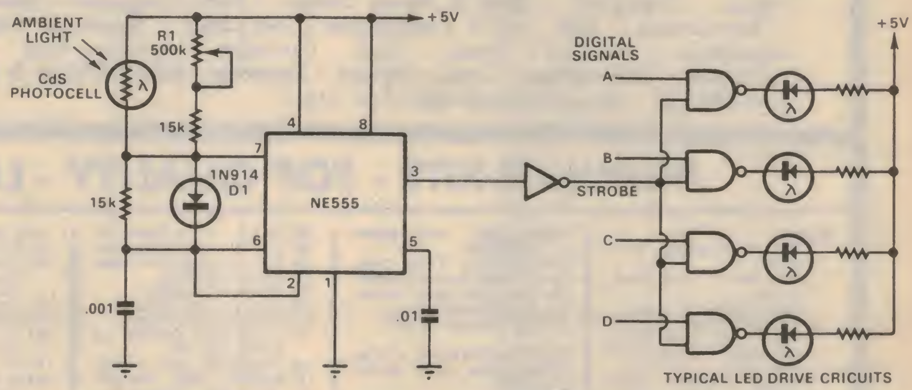
Interesting circuit ideas and design notes selected from technical literature, reader contributions and staff jottings. As they have not necessarily been tested in our laboratory, responsibility cannot be accepted. Your contributions are welcome, and will be paid for if used.

Timer IC and photocell vary LED brightness

The relative brightness of a light-emitting-diode display can be varied automatically by combining a cadmium sulphide photocell and a 555 timer into a pulse-width-modulated astable multivibrator. Such variability is obviously important in aircraft and automotive instrumentation, as well as in calculators and digital watches, or wherever ambient light conditions vary.

The circuit is the standard astable configuration for the 555, with two modifications – the photocell replaces one of the timing resistors, so that ambient light controls the duty cycle of the astable oscillator, and diode D1 bypasses the 15k timing resistor during the charging of the timing capacitor, increasing the maximum duty cycle of the 555 beyond the normal 50 per cent limit, and allowing the display to obtain full brightness.

As increasing ambient light level decreases the resistance of the photo-cell, the duty cycle of the timer increases. The varying duty cycle controls the length of time the display drivers are on and this controls the brightness.



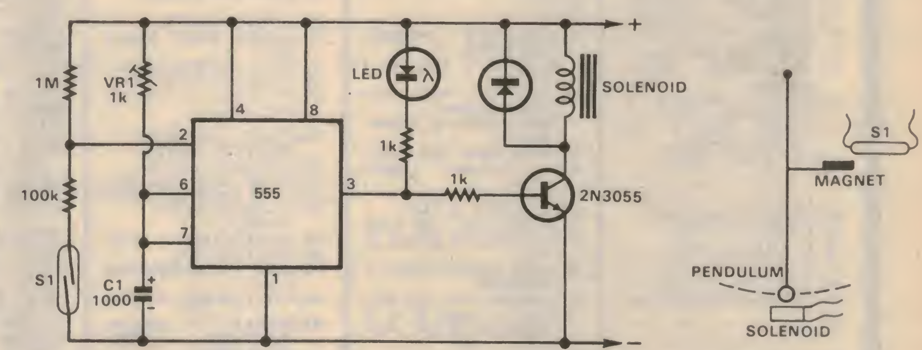
This circuit varies the duty cycle from less than 5 per cent in total darkness to more than 90 per cent in sunlight. Manually setting control R1 establishes the minimum brightness level in total darkness. However, if such an adjustment is considered unnecessary in a particular application, R1 could be replaced with a fixed resistor.

(By F. E. Hinkle and Jim Edrington, in "Electronics".)

555 chip impulses pendulum

Readers interested in horology may find this circuit useful; it uses a 555 IC to impulse a pendulum. The reed switch is closed when the magnet swings near the reed, about the end of the pendulum swing.

The timer is triggered and stays high for 1.1 x C1 x VR1 seconds and there can be no re-triggering until the output has gone low. Period adjustment is by VR1. The period should be adjusted until the LED just goes on when the pendulum is vertically over the solenoid so that the pendulum is pulled towards the centre and when it reaches the centre the force is removed.



If required, a TTL output for counters or the like can be taken from pin 3 of the chip via a potentiometer. Changes in supply voltage make little or no difference to the time period of the chip but will change the force exerted by the solenoid. The circuit may be operated from between 5 and 18V depending on the type of solenoid and amplitude needed.

Component values are not critical and were selected more because they were to hand. For example C1 was selected at 1000uF but can be something smaller with suitable alteration of VR1.

(By R. J. Wylde, in "Practical Electronics".)

Note on audio oscillator

As part of a test instrument I recently developed, I had need of a low disortion 1kHz oscillator of a small size. The 741 oscillator described in the November 1974 issue of EA looked interesting and was mocked up in the lab.

The distortion at 1kHz was .04% but increased to 0.8% at 7kHz and over 1.0% at 20kHz. As the performance at 1kHz was more than adequate, the circuit was successfully included in my development and no more thought of it until reading the article on page 50 of the January 1975 issue of EA.

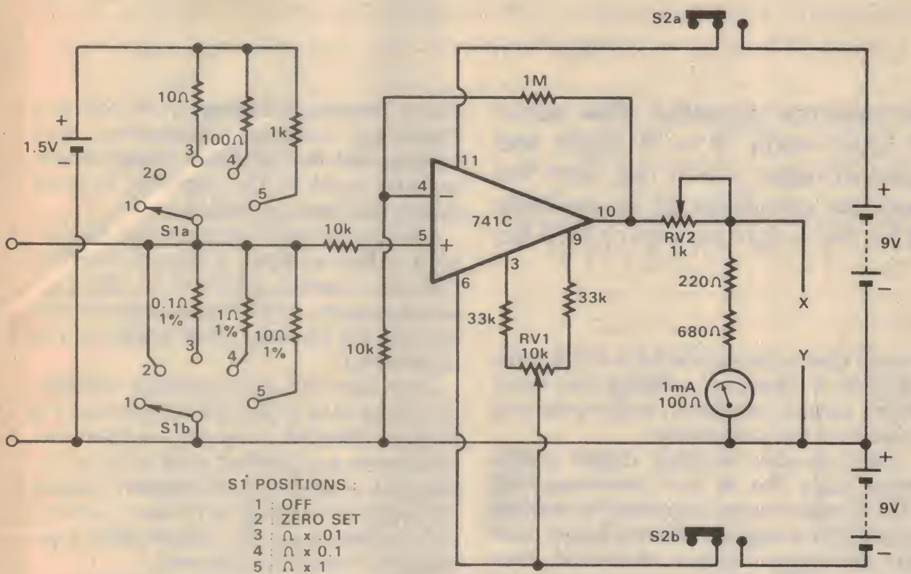
It would seem that a similar situation exists in that the open loop gain of the 741 above a few kHz can be insufficient to allow for much gain reduction (and

attendant distortion reduction) and still have the required gain of 3 to maintain oscillation.

Replacing the 741 with a 709 suitably compensated externally for a closed loop gain of 10dB would mean better high frequency performance for what is otherwise a deceptively simple, high performance oscillator.

(By Brian R, Rickaby, 17 Melina Street, Salisbury, Qld 4107.)

A low range ohmmeter

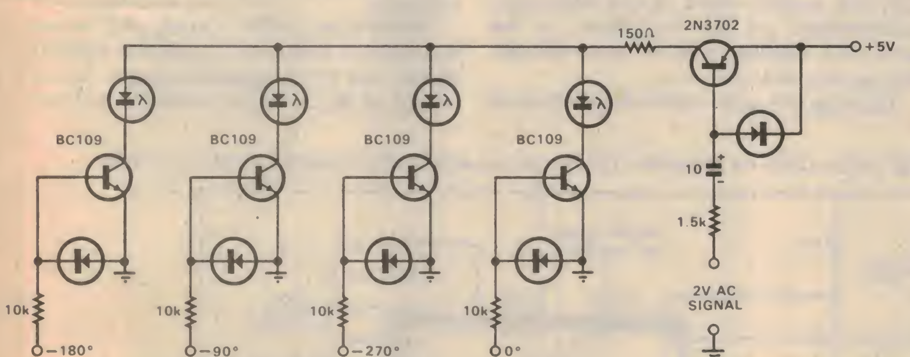


This ohmmeter fulfils a need for measurement of resistors from .01 ohm to over 100 ohms by comparing a resistor of unknown value with the selected 1% tolerance reference resistor. In operation the meter is zeroed by means of RV1 with the range switch set at position 2. In positions 3, 4 and 5 a voltage of almost 15mV across the reference resistor, coupled with an IC gain of 101 produces an output of about 1.5V and by adjusting RV2, the meter is set to FSD.

When connected, an unknown resistor forms a parallel circuit across the reference resistor lowering the voltage across it, thereby reducing the meter reading. Accuracy is better than 1% + or − the reference resistor tolerance. A meter having a mid-scale reading of 10 is necessary. Any VOM having this type of ohms scale could be used as the read-out by connecting the lower end of the 680 ohm resistor to OV and connecting the VOM set at the 1V range between points X and Y.

(By Colin Christensen, 17 Centour Street, Redcliffe, Qld 4020.)

A LED synchroscope



OUTPUTS FROM 5V REFERENCE OSCILLATOR

Here is another LED display to indicate frequency zero beat.

In attempting to tune an oscillator to a standard frequency it is convenient to be able to sense the direction of a phase error as one approaches the correct setting. Some instruments provide a cathode ray tube Lissajous figure display for this purpose, but the hardware required is rather inconvenient and expensive.

It is possible to generate something similar to a Lissajous figure using a few lamps and this is very familiar to power engineers in the form of a lamp synchroscope. With the advent of light emitting diodes, a low consumption version is possible for electronic applications.

A three-lamp system gives the neatest and most elegant display but it is generally more convenient to generate four phases from an existing signal source than three phases. Thus the circuit described is a four-lamp system.

The four lamps generate a display rotating once per cycle at the reference frequency. The display brightness is modulated at the frequency of the oscillator to be adjusted. The apparent display is therefore a rotation which appears to have a frequency equal to the difference between the two signal frequencies concerned and a direction indicative of the sense of the frequency difference.

The display is most effective when the lamps are mounted on the smallest practical pitch-circle diameter.

(By R. H. Pearson, in "Wireless World".)

Fluorescent Readout LSI Digital Clock

by LEO SIMPSON

So those other clocks we've published have not appealed. How about this one? It's very simple, 12 or 24 hour mode, 4 or 6 digits and uses very bright seven-segment fluorescent tubes which run from the common supply of only 22V DC. And the complete kit is available from Dick Smith Electronics at $24.95 for the 4-digit version or $29.95 for the six digit version.

As can be seen from the photographs, the clock circuit is accommodated on a compact PC board measuring 107 x 65mm. It can be built with four digits for hours and minutes readout, or with six digits to include seconds readout. In view of the small extra cost, we think that most buyers will opt for the six-digit version.

Even when the six-digit version is built, the total component count is not very high; transformer, five diodes, three capacitors, fourteen resistors, six fluorescent tubes and of course, the 24-lead "bug" from National Semiconductor, MM5314N.

We have already published a circuit using the NS MM5314N clock chip (LSI Digital Clock, September and October 1973, File 7/C/12) and we have seen several others using LED displays, but the circuit under discussion here is the most efficient in terms of utilising the clock chip's output capability, and minimising overall circuit complexity.

Most people building digital clocks these days like to use seven-segment LED displays because (a) they're modern and (b) they supposedly last longer than gas discharge displays. However, even where a LED display is operated in a time-shared mode (known as "multiplex" which we will explain later), the brightness is generally quite modest.

Not so with the miniature fluorescent display tubes used here. Everyone who saw the sample clock in our laboratory commented on the brightness of the attractive display. And its easy-on-the-eye-green, not red.

Perhaps the most interesting feature of these fluorescent displays is the low operating voltages. Basically, they operate like the luminous tuning indicator that used to be common in valve radios and tape recorders.

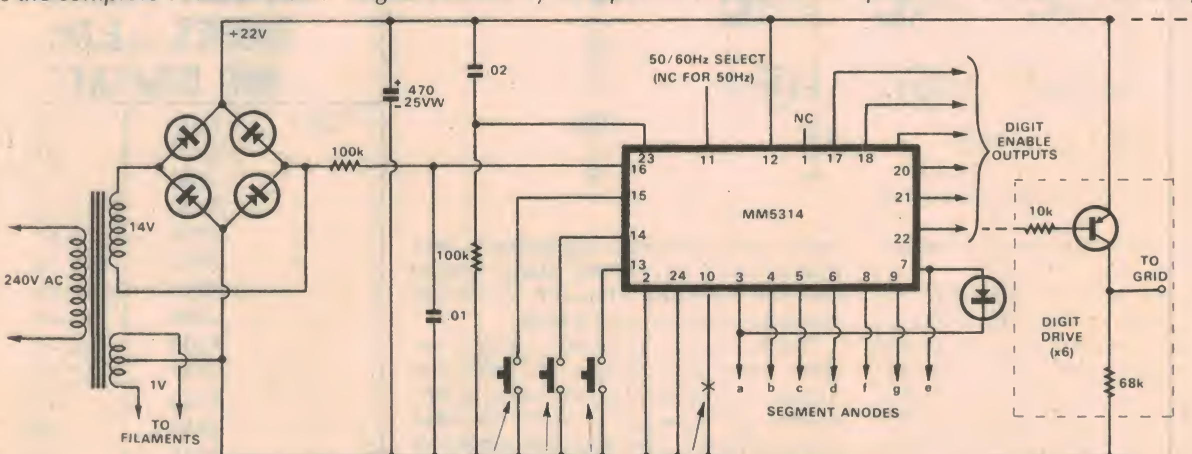
Like the tuning indicators, the fluorescent readouts have a directly-heated cathode, control grid and in this case seven anodes, one for each segment and one for the decimal point (which is not used here).

Two very fine wires running vertically down the face of the display provide the directly-heated cathode, or filament, whichever you prefer. One side of the filament is tied to the negative supply rail and it is fed from a 1V (yes, one volt only) winding on the transformer. Each filament draws 50 milliamps.

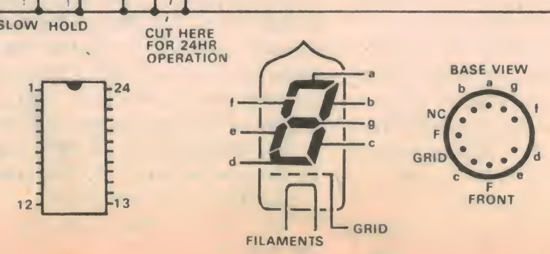
A fine mesh immediately in front of the seven anode segments is the control grid. When the anodes are connected to a suitably high positive potential, the display can be made to light up by making the grid positive with respect to the cathode.

In the case of this circuit, the anode potential is a little less than the positive supply rail of 22 volts (nominal). Actual height of the readout numerals is 8mm.

Below is the complete circuit of the new digital clock. Only six separate transistors are required in addition to the LSI chip.



LSI DIGITAL CLOCK



The current drawn by each segment is very low, of the order of 0.3 millilamps. This, combined with the low operating voltage of the tubes, means that the segments can be driven directly by the IC.

Contained on the LSI chip for the clock is all the electronic circuitry necessary to convert the 50Hz pulse input to pin 16 to a multiplex readout for six digits.

Now let us briefly describe the clock operation. First it has a divider-counter system similar in principle to the digital clock featured in June and August 1973 (File Nos 7/CL/10 and 7/CL11). It takes halfwave rectified 50Hz, squares it up in a signal shaping circuit, and then divides it down to 1 pulse per second (1 pps). The 1pps signal is fed to a counter which cycles in BCD from 01:00:00 to 12:59:59 continuously (in 12 hour mode).

BCD output from the clock counter is decoded and multiplexed to drive the display.

In simple terms, multiplexing is a method of simultaneously transmitting more than one piece of information via the one path. In the case of the clock described here, it is necessary to display up to six separate numbers simultaneously. Each number has up to seven segments and therefore requires seven items of information.

For a seven-segment display, eight separate lines are therefore required. Multiply this by six for a six-digit display, and we would need 48 lines, although when the clock operates in the 12-hour mode, the most significant digit is never larger than "1" and so will only need two segments; thus reducing the number of lines required to 43. If the clock chip used separate conventional seven-segment decoding for each digit, it would thus require 43 output connections plus all the input, supply and control connections. Rather an unwieldy package!

Multiplex operation gets around the problem by not attempting to show all digits continuously. Instead the digits are flashed sequentially, at a rate of about 1kHz; at this rapid rate, they all appear to be on continuously.

All equivalent segments of the various digits are tied to seven common lines, each driven by a segment driver output of the clock chip, pins 3 to 9. As noted above, the segments of the fluorescent tubes are anodes. At the same time, the grid of each fluorescent tube is driven by an NPN "digit driver" transistor (which are driven from pins 17 to 22 of the IC). Thus for a six-digit display, there are only 13 separate connections from the clock chip.

To display the various digits correctly, control signals are applied sequentially to the digit drive transistors, to apply grid voltage to each readout tube in turn. At the same time, the corresponding segment drive signals for each digit are applied to the common segment lines—the signals change appropriately as the grid voltage is applied to each readout tube.

There is one further interesting point about the readout system—the diode connected between pins 3 and 7 of the IC. This is to improve the appearance of the digit 6.

Referring now to the diagram, you will see that each of the seven segments of the readout tube is coded a, b, c and so on and the relevant pins of the IC are coded likewise. Thus the diode assures that whenever a positive signal is applied from pin 7 to the "e" segment line, pin 3 is also "pulled up" and a positive signal is applied to the "a" segment line.

This causes the "a" segment to be lit whenever the digit 6 appears and thus improves the appearance. The diode does not affect the muliplex operation when "a" and "e" segments are normally lit, as in the digits 2, 8 and 0. Note that you could operate the unit without the diode but then the short length of the "f" segment makes the digit 6 look unattractive with these readout tubes.

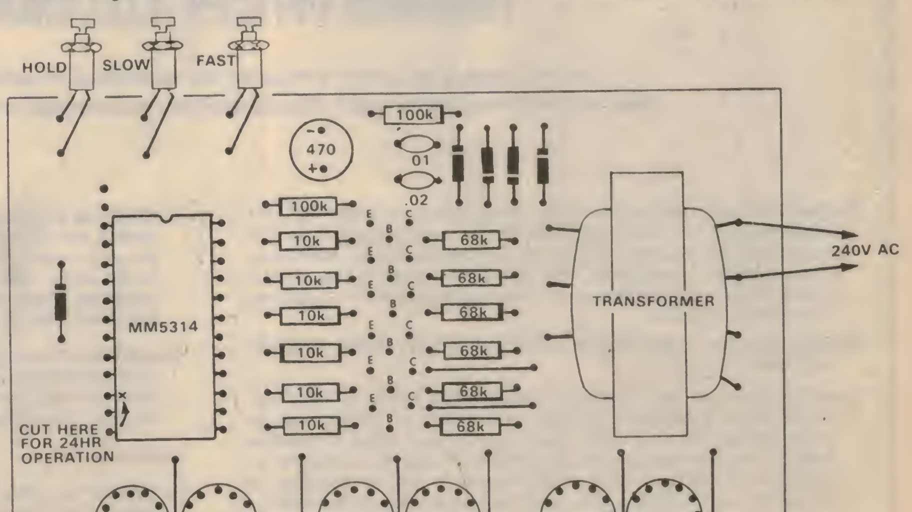
Each digit is thereby displayed at its appropriate position but only for a fraction of the time: for a four digit display, one quarter of the time and for six digits, one sixth of the time.

Three push-buttons are provided for time setting: Hold, Fast Slew and Slow Slew. The latter two buttons rapidly cycle the time forward. Using the Hold button, you can hold the display static until the precise time is reached and then let go. The clock will then keep time for as long as the mains supply is maintained.

The kit from Dick Smith Electronics is $24.95 for the 4-digit version and $29.95 for the 6-digit version, plus $1.00 for postage and packing where applicable. That price includes all the bits shown in our photographs, plus a three-core mains cord and plug.

It all goes together very quickly and there are few hassles involved. The base diagram of the readout tubes is shown on the circuit. Pin 3 is the filament connect and it is inserted in the hole(s) coded "F" on the board. All the other

At right, the clock in finished form, housed in the case which is also available from Dick Smith Electronics.



The component layout shows the relatively few parts required to complete the clock.

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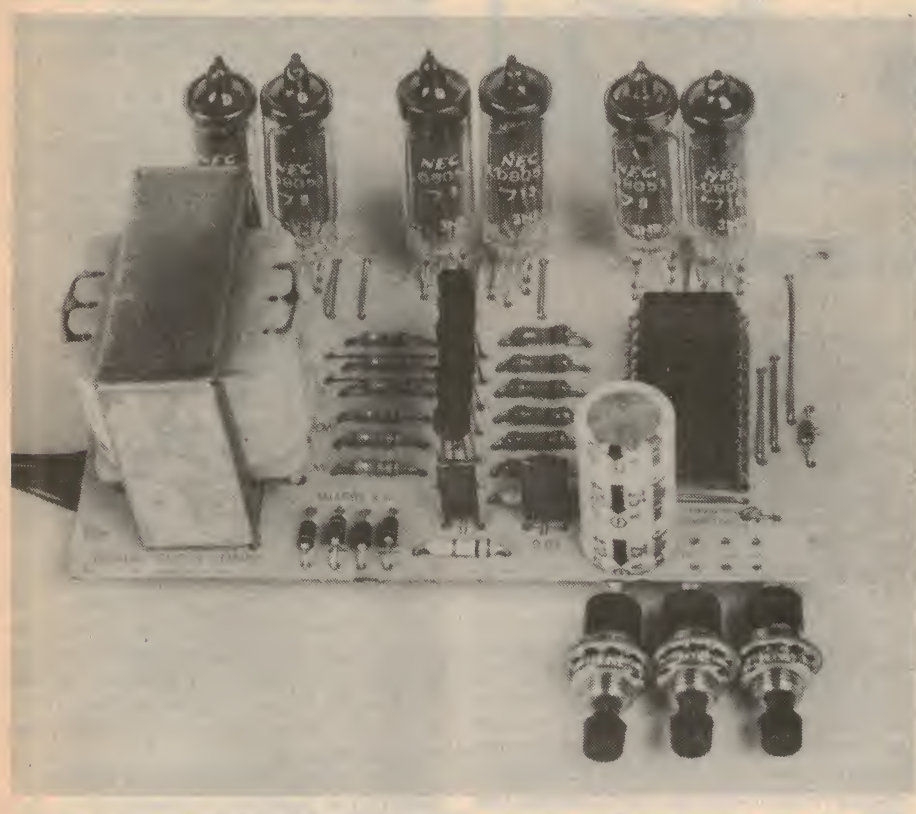
Location: Sydney.

Enquiries: Telephone Graham Donald on 20537 for further information. An inspection of facilities can be arranged.

Applications: In writing to the Director, National Acoustic Laboratories, 5 Hickson Road, Sydney, by 28th April, 1975.



Above is a general view of the PC board showing the switches temporarily attached.

pins are connected correspondingly, except there is no connection for pin 7. Cut that short.

Two integrated circuit connector strips (as made by Utilux and other companies) are supplied for the IC socket. Insert each section, solder all pins and then snap off the top portion so that each pin connector is separated from its neighbour.

Omit the link for 50Hz/60Hz selection. If you want to operate the clock in the 24-hour mode, cut the copper link on the board between pins 2 and 10. When all connections are complete and ready to go, insert the IC—the orientation is shown on the top of the board.

Note that when the clock is initially switched on, it will show a random digit pattern with perhaps some or all of the digits blanked out. This is corrected by using the time-setting push-buttons.

At the time of writing, Dick Smith was on the point of arranging for an attractive case to be made available for the clock. Failing that, the new plastic cases measuring approximately 140 x 70 x 130mm (W x H x D) and distributed by Soanar Electronics Pty Ltd are suitable for the job. These cases are available from most parts suppliers, including Dick Smith Electronics.

One final point: it is wise to mount the time-setting switches on the rear of the case, otherwise people will fiddle. But you must admit there certainly is a temptation, with such a nifty design!

Classical Recordings

Reviewed by Julian Russell

Pfitzner: a strange fascination

PFITZNER—Palestrina. Complete Opera. Nicolai Gedda, Fischer-Dieskau, Bernd Weikl, Karl Ridderbusch, Helen Donath, Brigitte Fassbander, Hermann Prey and others with the Chorus and Symphony Orchestra of the Bavarian Radio, conducted by Rafael Kubelik. DGG Stereo 2711013. (Four Discs.)

How many people know Hans Pfitzner by anything but a name? In all my many years of concert going here I cannot recall having heard any performance of one of his works—and he was a very industrious composer. Yet his music is revered in Central Europe and his opera Palestrina is firmly established in the repertoire of all the best opera houses. It has a very large cast and, in this recording, many of the roles are sung by most illustrious performers.

Its story is as odd as it is complex: Palestrina (1525-1594) had his ups and downs. Most "downs" were due to the fact that he was a married man in, as a church dignitary, a celibate job. But this was finally resolved and he went on to live in sufficient comfort to compose much matchless music. But Pfitzner as a young man saw Palestrina's life in much more dramatic terms. According to Pfitzner's interpretation of history, music, especially church music, had for many years been in decline. Indeed all the polyphonic music ever written was likely soon to come under a Papal decree to be destroyed. And, says Pfitzner, Palestrina imagined his predecessors reaching out from their graves in a plea to him to "Save music!" And again, according to Pfitzner, Palestrina was accorded divine help to accomplish this task.

The plot is therefore divided into two parts, Acts 1 and 3 depicting Palestrina and his mysticism, Act 2 showing the worldly side of the period's civilisation. The opera has some very moving music, still held in awesome esteem in Germanic countries, though considerably less elsewhere. I have never seen the opera but many of those musicians who have tell me that, despite its content of some really great music, as a stage work it fails. This I can well understand because its massive libretto, which the composer wrote himself without any previous experience in this discipline, is of great complexity.

This superb recording, rich in every sense of the word, cannot fail to impress all who hear it but whether it will convert any but the already converted is problematical. Its dramatic demands are formidable, its intellectual arguments equally so. And, unless you are prepared to work hard at their solutions, you might well dismiss the composer as just another great Teutonic bore—like his countryman Max Reger. It is, however, my firm opinion that this recording might well go far to destroy average Anglo-Saxon prejudice against his reputation. The libretto is a bold if never quite successful attempt to illustrate elusive points. There is even an effort to reconstruct musically the famous Council of Trent with all its theological twists and turns. Bold indeed, but all too quixotic for the average unconvinced audience.

Pfitzner leaves too much to the imgination. He writes glowingly of Palestrina's great Missa Papae Marcelli, his struggle with its completion and its effect on the rest of his life, without giving any further elucidation. Many of the dramatic effects remain unresolved and remain hanging tantalisingly in the air. And the opera, despite its many beauties, seems of irksome length; the first act alone runs for just on two hours.

Available space does not permit of recounting the many ramifications of the plot. Most of the music is almost obsessively diatonic and owes much to the similar musical style of Wagner's Mastersingers. To write more about it would involve me in lengthy descriptions not readily apparent at a first, or even subsequent hearings and would in no way explain its dramatic vagaries.

Kubelik presents the work con amore—he required over 24 sessions to record it. But his love of the work communicates itself unmistakably to all those associated with its glorious production. Kubelik's only less than convincing section—and it may well be the composer's—is a lack of true sublimity in the "angel" scene. But here is, on the whole, as fine a recording that I can imagine of a work so many musicians—and others—have heard about but have never heard. It is worthy of a place in every serious record library. I certainly would not be without my copy now that I have come to learn something about its strange fascination.

More useful information is well covered in the brochure accompanying the handsomely boxed set. All the members of the distinguished cast are in top form and the orchestral playing faultless. But, as I remarked earlier, you will have to work hard on it before its many merits are appreciated.

Mozart: close to perfection

MOZART—Die Entfuhrung aus dem Serail. Complete opera. Otto Mellies (Pasha Selim); Arleen Auger (Constanze); Reri Grist (Blondchen); Peter Schreier (Belmonte); Harold Neukirch (Pedrillo); and Kurt Moll (Osmin). Der Schauspieldirektor. Kurt Moll (Buff); Peter Schreier (Vogelsang); Reri Grist (Madame Herz); Arleen Auger (Madame Silberklang). Both with the Dresden Staatskapelle conducted by Karl Bohm. DGG Stereo 2740 102.

Karl Bohm, always a fine conductor, seems to grow in stature with his years. He must now be in his 80s and gives strength to the adage that conductors fulfil useful lives as long as priests. The works he conducts seem also to grow in stature with him. At any rate this is evidenced in his new recording of this opera. When it was first given in 1872 Il Seraglio was advertised as a "comic singspiel." Singspiel it is—a form of musical entertainment with dialogue between the musical items—but this performance cannot be said to be comic in any way. On the contrary it exemplifies just how Mozart freed the singspiel form from its previous shallowness and flippancies. Thus neither of these terms can be used to describe Fidelio (Beethoven) or Der Freischutz (Weber) though in both spoken dialogue is used.

The form survived until recently in French Opera Comique and even Richard Strauss used it. But the Mozart work changed its nature radically, a point which Bohm makes clear in his interpretation of it. It has its occasional amusing moment or situation but is fundamentally intensely serious. By that I don't mean that Bohm's reading is dour. On the contrary. He simply gives the whole work much greater depth than is usually allotted it. He presents it as a study in the strength and endurance of love. One of the women characters is not named Constanze for nothing. And the Turkish character Osmin, usually presented as a figure of fun is here a very sinister person indeed.

Without going into further details of Bohm's unique performance we can go straight to its general excellence of presentation. The Dresden Staatskapelle is

seldom heard on discs but its performance here confirms its place among the world's best operatic orchestras. You have only to play the first few bars of the opening to decide this for yourselves. The playing is clean with luminous tone, and even if some of Bohm's tempos tend to be a little on the slow side they lose nothing in vitality and all through his pointing reminds one of the old saying that "in the beginning there was rhythm."

The sound is as close to perfection as can be imagined, the balance between orchestra and singers always scrupulously sustained. The score contains many hints of the later Mozart, especially in its treatment of the two lovers, Belmonte and Constanze, who reach truly tragic heights in their final duet. Among the always first rate male singers Schreier's Belmonte is outstanding in quality of tone and beauty of phrasing and Osmin runs him a close second in his sinister vocal and dramatic projection of the role. He is also notable for being a bass who can deliver a real trill without making it sound close to the ridiculous. The other men are all good and under Bohm's direction offer perfect Mozartian style.

If Arleen Auger sometimes hardens on a top note in order to fill out her otherwise pure but rather colourless voice, she, too, can be listened to with enjoyment and not too many reserves. The other woman principal, Blondchen, is a little on the thin side in her extreme upper register but, after all, you can't have everything. Otto Mellies has fine dignity as the Pasha.

But these minor—and I stress minor—shortcomings can all be ignored under the influence of the conductor's inspired direction. Happily the spoken dialogue is delivered by actors and not the singers except in the case of the Pasha, whose speaking voice is as well modulated as his singing. He enunciates beautifully and, more importantly, convincingly. This is a recording I shall always cherish no matter the quality of any other that might follow it. And if you are looking for a definitive account of the opera, here it is.

★ ★ ★

BEETHOVEN—Violin Sonatas Nos. 4 in A Minor and 6 in A Major. Yehudi Menuhin (violin) and Wilhelm Kempff (piano). DGG Stereo 2530 458.

This disc is one of a complete set of Beethoven's works for violin and piano originally recorded for Polydor in 1970. It is the first one I have heard and is so good that I hope more will follow. On this disc you have two admirably matched players of great renown collaborating in complete accord. The A Minor is a restless type of work that denies both players their "bit of fat" in the form of a luscious slow movement. Instead there is a longish, slowish scherzo type of movement even here not entirely free from restlessness. Hence I imagine its rare performances in the concert hall. Yet it is never without interest especially in the antiphonal style of the first movement. Without the fascination of such entrancing playing the sonata might well lose much of its interest despite the delicious Mozart-type second subject in the first movement. If you are looking for what could be described as a Beethoven novelty here is one you're unlikely to hear better played or recorded—slightly resonantly—for years to come. Just one point—a shorter, brisker Finale concludes the work though this doesn't seem to go at the marked tempo—allegro molto.

The A Major is a much showier piece in which both soloists have their fair allotment of rewarding passages and plenty more when playing together. And in this sonata you have a lovely slow movement, adagio molto espressivo, that should satisfy the most demanding of melody hunters. Both artists play it with alluring warmth and complete absence of exaggeration or any other kind of fuss. The last movement consists of a theme and six variations, the whole as happy as anyone could desire. And in neither Sonata will you hear the violin figurations that so often can become tedious when used as an accompaniment to the piano solo part.

★ ★ ★

BARTOK—Violin Concerto No. 1 (1908) and Viola Concerto (1945) played by Yehudi Menuhin (violin and viola) and the New Philharmonia Orchestra conducted by Antal Dorati. World Record Club Stereo S/5249.

Unfortunately I can only deal briefly with this very fine issue. I can strongly recommend it for Menuhin's splendidly idiomatic playing and that of the New Philharmonia under Antal Dorati. Neither the Violin nor the Viola Concerto—both played by Menuhin—should prove difficult for anyone used to Bartok's music, although the first was a very early work and the second the last he ever wrote. Further interesting details about the unusual circumstances of their composition are contained in Malcolm Rayment's admirable sleeve notes. The disc is a first-rate bargain at its club price.

For information on World Record Club albums, contact the Club at 605 Camberwell Rd., Hartwell, Vic. 3124. Tel. 29 3636.

Variety Fare

Reviews of other recordings

Devotional Records

THE CHURCH IS SINGING AGAIN. Richard & Patti Roberts and the World Action Singers. Stereo, Light LS-5628-LP. Also on cassette. (From Sacred Productions Aust, 181 Clarence St, Sydney and other capitals.)

There are three medleys on each side of this album and, looking at the titles, one expects to hear a bright but otherwise conventional singalong of well known hymns and choruses.

The words are familiar, yes, and most of the selections lay down the traditional melody and tempo. But then the arrangers take over to create a modern youth sound. Let it be said that the World Action group, working under Ralph Carmichael, is very polished but, to my traditional ears, they sounded best doing the traditional rather than the up-tempo segments. I'm sure, however, that younger listeners would react just the other way.

The six medleys involve five titles each so let me just quote the medley title and one typical number in each: Singing (In My Heart There Rings A Melody)—Walkin' (Just A Closer Walk)—Deliverance (He Is Able To Deliver)—Love (The Love Of God)—Light (Sunlight, Sunlight)—Spirit (Spirit Of The Living God).

An imported album, the sound is good and you'll enjoy it if you like the idea of an up-tempo singalong. (W.N.W.)

★ ★ ★

EVIE. Evie Tornquist, with orchestra arranged and conducted by Lennart Sjoholm. Stereo cassette, Word WC-8628. Also available on disc. (From Sacred Productions Aust, 181 Clarence St, Sydney and other capitals).

Evie Tornquist is a new name to me but, to judge by this cassette, she is blond, cheerful and personable, and thoroughly at home fronting a big band or orchestra. Most of the numbers on the album are also new to me and with big beat backing, but two or three are better known, even traditional:

My Tribute—Sweet Song Of Salvation—The Blood Will Never Lose Its Power—Movin' In The Spirit—I Surrender all & I Need Thee Every Hour—Praise The Lord He Never Changes—One More Day—Say "I Do"—On The Wings Of A Snow White Dove—Would You.

As you've probably gathered, the emphasis overall is modern and up-tempo and its main appeal will be in that direction. But let this be said, Evie has a pleasant, well trained voice and I don't think the oldies will be too stressed if the teenagers insist on getting their money's worth. An imported cassette, the quality is good. (W.N.W.)

★ ★ ★

IN DULCI JUBILO. Carols from Cambridge. Clare College Singers and Orchestra. World Record Club stereo S/5749.

It may seem a little late to review an album of Christmas carols but there is no reason why you cannot buy it now in time for Christmas 1975. It's not all that far away. And this is quite an unusual album, anyway. About 70 amateur performers from Cambridge University give a marvellous rendition of a group of mostly traditional carols. Record quality is very good with just a trace of tape hiss.

Fourteen carols are presented in all: Shepherd's Pipe Carol—Infant Holy, Infant Lowly—Angel Tidings—Quelle Est Cette Odeur Agreable—Once In Royal David's City—Il Est Ne Le Divin Enfant—Of The Father's Love Begotten—I Saw Three Ships—Down In Yon Forest—In Dulci Jubilo—Nativity Carol—Quem Pastores Laudavere—Rocking—The Twelve Days Of Christmas. (L.D.S.)

Instrumental, Vocal and Humour

HEAVY ORGAN AT CARNEGIE HALL. Virgil Fox. Stereo, RCA ARL1-0081.

When this album turned up on the RCA release sheet, I assumed that it might feature the new 5-manual Rogers classical electronic organ, which has recently been installed in Carnegie Hall. But, while this is a Rogers classical electronic, it is one of the less pretentious models that cleared the way for the big one.

Again, this looks like a traditional, classical recital but it isn't. It was a pre-Christmas (1972) concert in which Virgil Fox did his own Bach thing, with spoken commentary, psychedelic lights, and a capacity audience cheering, clapping and whistling like soldiers at a camp concert!

The sight and sound spectacular features Fugue in C Minor—"Little" Fugue—Ariosa from Cantata No. 156—Toccata in F—Fantasy and Fugue in G-minor ("Great")—In Thee Is Joy—Adeste Fideles (in which the massed audience is invited to sing). Needless to say, Virgil Fox emerges as the virtuoso he is, even if here in gay mood.

What of the organ itself? It has all the voices and the weight appropriate for such an occasion but for some reason (organ, acoustics, recording?) the treble lacks the character and the piquancy that adds so much to listening interest. And the bass, while massive, lacks the real profundity of big pipes.

I can well imagine that, on the occasion, the sound was appropriate to the total spectacle. On its own, it has to compete on a quite different basis. I'm not saying you won't enjoy it but you'd better know what you're buying. (W.N.W.)

★ ★ ★

BEST LOVED GERMAN SONGS. Eric Kunz, baritone, with the Vienna State Opera Orchestra, conductor Anton Paulik. Stereo, World Record Club S/5394.

Originally released on the Vanguard label around 1960, this disc has some technical limitations, but musically it must be rated "excellent". It contains a fine selection of songs by the great German and Viennese composers, capably sung by Kunz who was still at the peak of his career at the time.

Represented are Schumann, with his stirring song The Two Grenadiers, and The Nut Tree; Brahms, with The Sandman and Serenade; Schubert, with To Music, Who Is Sylvia, and Laughter and Tears; and others by Mozart, Beethoven, Liszt, Hugo Wolf, Friedrich Silcher and Max Reger.

Particularly enjoyable are the settings by Hugo Wolf, including his delightful "Epiphany", an ironic account of the travels and motives of the Magi; and the charming nativity song "Sleeping Christ Child". Liszt's setting of Heine's poem "Die Lorelei" is followed by the much better known and more popular setting by Friedrich Silcher. (H.A.T.)

Reviews in this section are by Neville Williams (W.N.W.), Harry Tyrer (H.A.T.), Leo Simpson (L.D.S.), Gil Wahlquist (G.W.), and Norman Marks (N.J.M.).

VIOLIN CONCERTO No. 6—Paganini. Salvatore Accardo, violin, with the London Philharmonic Orchestra, conducted by Charles Dutoit. Stereo, D.G.G. 2530 467.

Paganini's long-lost concerto in E minor here receives its world premiere performance by Accardo, who seems well able to handle its technical difficulties, even if these are not so tormenting as in some of the later works by this composer. (Despite the designation "No. 6" it is apparently a fairly early work.) This fact alone will undoubtedly stimulate sales, but I cannot imagine this work achieving the success of the Paganini concerto at present in the repertoire.

It is a meretricious work, with a flashy solo part designed to highlight the skill of the performer, and after three hearings I have not yet been able to discern much musical merit. Apparently only the solo violin score was found, and the orchestral accompaniment by Federico Mompellio, whoever that is, is virtually only a harmonic background for the soloist. The recording is good. (H.A.T.)

★ ★ ★

GREATEST HITS OF THE 30's. Arthur Fiedler and Boston Pops. RCA Red Seal stereo ARL1-0042.

GREATEST HITS OF THE 20's. Arthur Fiedler and the Boston Pops. RCA Red Seal stereo ARL1-0041.

For those who like popular tunes arranged to suit a large orchestra, these two albums from Arthur Fiedler and the Boston Pops provide a veritable feast. And if you are a real hifi fan to boot, you will be pleased to read that the sound quality is really excellent.

Music from the 20's album includes: Dancing In The Twenties—Strike Up The Band—Star Dust—Deep In My Heart Dear—The Man I Love—Wonderful One—A Pretty Girl Is Like A Melody—Rhapsody In Blue.

Tracks from the 30's Album are as follows: Jalousie—Moonlight Serenade—Deep Purple—Sweet And Lovely—September Song—Embraceable You—The Song is You—These Foolish Things Remind Me Of You—Stairway To The Stars—Smoke Gets In Your Eyes—You And The Night And The Music—Through The Years. (L.D.S.)

★ ★ ★

FOR MY FRIENDS. Arthur Grumiaux, violin, with Istvan Hajdu, piano. Stereo, Phillips 6599 372.

"Arthur Grimiaux plays his best loved encores"—this line on the sleeve is sufficient indication of the type of familiar light classical fare offered here. However, the list does contain a few surprises. The titles: Sicilienne (Paradis)—Rondo (Mozart)—Melodie (Gluck)—Spanish Dance No. 5 (Granados)—Schon Rosmarin, Liebesleid, and Liebesfreud (Kreisler)—Allegro (Veracini)—Siciliano (Vivaldi)—Tambourin (Leclair)—Minuet in G (Beethoven)—Ave Maria (Schubert)—Humoresque (Dvorak)—Meditation (Massenet)—Valse Sentimentale (Tchaikowsky). Even if you do not recognise these immediately by these titles, you will almost certainly know most of the tunes when you hear them.

I have always been partial to Grumiaux's style of playing, with sweetly mellow but full bodied tone, but here there seemed to be a slight "edge" which could perhaps be in the recording. Note, however, the use of the word "slight" above, and do not let this criticism deter you if the program appeals. (H.A.T.)

Earthquake: music from the film soundtrack

EARTHQUAKE. Music from the original soundtrack. Composed and conducted by John Williams. Stereo, Astor MAPS-7640.

Read the track titles and listen to this highly thematic music and you can just about guess what the picture is all about. In fact, here are the titles: Main title "Earthquake" (complete with earthquake sounds)—Miles On Wheels—City Theme—Something For Rosa—Love Scene—The City Sleeps—Love Theme—Cory In Jeopardy—Something For Remy—Medley (with earthquake sounds): Watching & Waiting, Miles Pool Hall, Sam's Rescue—Finale, End Title.

Actually, I found the music very listenable with the added interest that the variety of instrumental sound invites attention in the technical sense. Some edginess in the full orchestra might deter one from regarding it as a demonstration record but the clarity and separation of solo and more sparsely orchestrated segments are outstanding. It's good stereo and it's even better quadraphonic, even if by accident!

Finally there's the earthquake background to "Medley" on side 2. This had to be transferred from the "Sensurround" electonic noise generator and merged with the normal soundtrack material on to a master tape, flat to 20Hz. When transferring it to a record, the automatic groove spacing could not cope with the unusually low frequencies and high amplitudes and had to be over-ridden.

Played at slightly above normal volume and with just a touch of bass boost, you can have your own modest earthquake in the living room—provided your pickup and loudspeakers will cope. Fortunately, mine did.

If you want an encapsulated impact from the album, don't say anything by way of warning. Set the system for a little extra volume and a little extra bass and start with side 2 track 2—from there to the end. An interesting release. (W.N.W.)

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GREATEST HITS OF THE 50's. Arthur Fiedler & The Boston Pops. RCA Red Seal stereo ARL1-0044.

This really enjoyable record is one of a series featuring the best hits of each decade from the roaring twenties to the present day, played in the Boston Pop's usual faultless style.

The titles are: Love Me Tender—Blue Tango—Tonight—Mack The Knife—Tennessee Waltz—Hernando's Hideaway—Seventy-Six Trombones—Gigi—"Peter Gunn" Theme—Song From "Moulin Rouge"—Love Is A Many Splendoured Thing—The Yellow Rose Of Texas.

Some purists tend to denigrate the Boston Pops for their popularising of some "serious music" as well as their popular output. I believe that music is for enjoyment and this type of record certainly supports that belief.

The quality is excellent, with negligible surface noise. (N.J.M.)

★ ★ ★

WAGNER DUETS. Kirsten Flagstad and Lauritz Melchior. Mono, RCA Victrola Vic-1681.

Despite their long association on stage at New York's Metropolitan Opera, Flagstad and Melchior made very few recordings together; in fact, this single LP contains everything they ever recorded together, although of course they recorded a great deal separately. Here we have the Love Duet from "Tristan and Isolde" (17 minutes, recorded November, 1939)—The Bridal Chamber Scene from "Lohengrin" (18¾ minutes, November 1940)—The lengthy duet of Kundry and Parsifal from the second act of "Parsifal" (33 minutes, also November, 1940).

Almost 69 minutes of Wagner, featuring two of the most renowned Wagner interpreters of this century, and at the Victrola price, should be sufficient to tempt anybody with a taste for historical recordings such as this. (H.A.T.)

★ ★ ★

NOBODY DOES IT LIKE ME. Shirley Bassey. United Artists' stereo L 35278.

On this album Shirley sings as well as ever but I feel that it is spoilt a little by the noisy and over-involved musical backing. It should be made simpler and quieter—a four-piece combo would be quite adequate. Record quality is good and surface noise is not a problem—it's drowned out by the noise!

Ten tracks are featured: Leave A Little Room—When You Smile—All That Love Went To Waste—Davy—I'm Not Anyone—Morning In Your Eyes—The Trouble With Hello Is Goodbye—Nobody Does It Like Me—I'm Nothing Without You—You Are The Sunshine Of My Life. (L.D.S.)

★ ★ ★

BLESS THIS HOUSE. Stuart Burrows, Tenor; Eurfryn Jones, piano and organ. Stereo, World Record Club/5313.

Stuart Burrows, well known as a Welsh tenor, and one with considerable operatic experience, turns his talents here to a recital of traditional songs—songs of faith, songs of Ireland and drawing room ballads. Traditional in style, musical "chestnuts", pure nostalgia perhaps, but I doubt that many have sung them better.

The titles are: Passing By—Oft In The Stilly Night—Thora—Macushla—Roses Of Picardy—I'll Walk Beside You—Bless This House—Because—Gortnamona—I Hear You Calling Me—Maire My Girl—Trees—The Holy City—Ave Maria.

Technically, the sound is clean without being pretentious and the stereo spread is limited. But it is adequate for a recital like this and you will enjoy it if your memories and inclinations go back to the relevant era. (W.N.W.)

Books & Literature

Transistor data

SEMICON INTERNATIONAL TRANSISTOR DATA MANUAL, 1974 edition. Published by Semicon Indexes Ltd, Wokingham, Berkshire, UK. Soft covers, 185 x 255mm, more than 400pp. Price not stated.

This is the latest edition of the transistor data manual in the well-known Semicon Index, and has been extensively revised and updated. Even more than with earlier editions, it is a most comprehensive guide to the identification, use, testing and substitution of discrete bipolar transistors and FETs. In fact it must surely be the most complete such guide available, with about 24,000 different devices listed.

The current volume supersedes all past editions. It has seven sections, the first of which is an introduction giving definitions, codes and symbols. This is then followed by a listing of manufacturers' names and addresses—which is most comprehensive and international.

The five remaining sections form the technical data proper. These provide in turn an alphanumeric listing with data on bipolar devices, a similar listing for FETs, a comprehensive substitution guide, a combined data and substitution listing for CV numbered devices, and finally a section giving base connections.

To enable holders of the current issue to keep up to date until the release of the next edition, the publishers offer a free updating service which may be requested by means of a reply card included in each copy.

In short, then, a most thorough reference on discrete transistors, and one which is worthy of a place in any laboratory or service shop.

The review copy came direct from the

publisher, and no details were given as to price or local availability. However I imagine that copies will be available from local bookstores by the time you read this, or shortly after. (J.R.)

Radar theory

RADAR PRECISION AND RESOLUTION, by G. J. A. Bird. Published by Pentech Press, London, 1974. Hard covers, 143 x 222mm, 160pp, with 56 illustrations. Price in UK £5.80.

A rather deep and specialised volume, written primarily for the engineer working on radar system design. It is concerned with the theoretical concepts underlying the sophisticated modulation techniques used in modern radar systems, and in particular with transform theory and the radar uncertainty function.

The first half of the book is devoted to the uncertainty function, dealing in turn with the theory, physical significance and limitations. The second half then gives an exposition of Fourier and Hilbert transforms, with proofs given for all major results.

For those working in radar design or research into signal processing, it could be of great value.

The review copy came direct from the UK publisher. (J.R.)

New Products

Automotive test equipment from Ferrier

Ferrier Electrical Instruments have just announced two additions to their range of automotive test equipment. One is a tachometer/dwell/voltmeter, model 209. The other is an exhaust analyser of the thermal conductivity type, model 210. Both feature large, easy-to-read meters and controls.

To the average electronics enthusiast, the need for a special automotive voltmeter is not immediately obvious. Why can't the automotive serviceman use a small general-purpose multimeter, which would seem to be more than adequate, at a fraction of the price of a specialised design?

In fact, there are several reasons which add up to a strong case for a special purpose instrument.

The average automotive serviceman is not an electronics specialist and is interested only in a few specific voltages. A multiplicity of ranges, or ranges which do not favour those specific voltages are only likely to confuse or to lead to inaccurate readings. This can also be significant for the customer if he has to be shown that there is something amiss with the voltage in the vehicle.

A second major consideration is that automotive voltmeters often have to be used in awkward situations, in poor light and viewed from awkward angles. A large, uncluttered scale is not just a luxury; it is a necessity.

Ferrier Instuments also stress the need for an automotive instrument to be physically rugged and capable of maintaining accuracy in any physical position. This is the basic difference, they say, between an instrument built to industrial standards and its much cheaper counterpart, often aimed more at the handyman market.

The Ferrier model 209 voltmeter comes with spring clips, rather than prods, enabling it to be attached to points in the wiring, but most frequently to the distributor terminals. The main voltage scale is calibrated 0-16V with zones marked for the normal "start" and "charge" conditions. There is provision also to measure the voltage across the closed, stationary points, including a press button which increases the meter sensitivity by 10 times. The voltage is interpreted as points resistance and read in terms of "good" or "high".

With motor running and the instrument clipped across the distributor points, it can be set to read RPM (revolutions per minute) against scales calibrated for 4, 6 or 8-cylinder motors. Speed range is 0-6000rpm for 4-cylinder motors, 0-4000 for 6-cylinder and 0-3000 for 8-cylinder.

A third scale is for dwell angle, again for 4, 6 or 8-cylinder motors.

Ferrier Instruments say that the voltmeter function can be expected to be accurate within 1%, while the tacho and dwell readings will typically be within 3%.

The exhaust analyser, model 210, is of the thermal conductivity type, operating on the principle that the exhaust gas produced as a result of different fuel/air ratios exhibits a different cooling effect—a function of its thermal conductivity.

A sample of the exhaust gas is taken by inserting the analyser's flexible hose into the tail pipe of the vehicle under test. Inside the analyser, the gas passes a gas cell in the sensing circuit—essentially four platinum resistance elements in a bridge which have been heated electrically by means of the analyser's internal batteries. The modifying effect of the gas on the bridge is apparent in the meter reading, against a scale which is calibrated in terms of fuel/air ratio.

Scales on the face show percentage combustion and mixture in terms of lean-normal-rich. Provision is made for gasoline, butane and propane fuels. Ferrier Instruments say that the basic meter movement in this instrument is manufactured and set-up to the same high standards as the voltmeter but, as with all such instruments, the readings will depend somewhat on peripheral conditions.

Designed to present a uniform appearance, the instruments are fitted with Australian-made Ferrier meters measuring 119 x 102mm. Overall size in mm is approx. 197h x 134w x 112d, excluding the analyser gas connection. Prices and further information are available from Ferrier Electrical Instruments, 47a Penrose St, Lane Cove 2066. W.N.W.)

Female patch cords

Cambion has introduced a new series of 0.040 female insulated patch cords, resulting in a completely new way to patch circuits with Cambion cage jacks. The new series 445-3409 patch cords permit patching of 0.040 plugs on conventional terminal boards and PC boards, without using the usual technique of combination plug/jack piggyback patch cords.

The new range is available in colours of red, black and blue. Special colours are possible on order.

For further information, contact General Electronic Services, 99 Alexander St, Crows Nest, NSW 2065.

Wavetek Model 30 Audio Sweep Generator

While an audio sine/square wave generator has long been considered an essential in any laboratory or workshop, there is often a need for an audio signal generator which can automatically sweep through its ranges. Fulfilling that need is the Wavetek Model 30.

Wavetek's Model 30 is a compact, battery operated audio function generator with dial control or sweep control of the signal frequency. Overall frequency range is 2Hz to 200kHz and sine-wave output is variable from zero to just over 1V RMS at 600 ohms output impedance.

A rechargeable nickel-cadmium battery is housed in a separate removable compartment on the rear of the case. An overnight charge of the battery gives 3 hours of generator operation and connecting the optional charger gives unrestricted operation.

"Neat design" sums up the format of the Model 30. Removing four screws allows the back of the case to be completely removed and allows access to the large PC board while all functions operate normally. Removing one further screw and the four control knobs allows the PC board to be taken out of the case without unsoldering any connections. The jack sockets on the control panel connect to the board via quick-connect terminals and the control pots and switches are soldered directly to the PC board.

Design of the case allows the front panel to be horizontal or vertical, whichever is more convenient. Besides the two sockets for sine and square wave out on the front panel, there is a long row of screw terminals at the rear for various inputs and outputs.

Apart from having a large number of passive components, the double-sided PC board accommodates fifteen transistors, five diodes, one zener, seven integrated circuits and three diode arrays (which look like IC's.)

Besides the frequency dial, there are three control knobs, designated Range, Mode and Amplitude. The last-named is the output level control.

There are seven positions on the mode control, which also acts as the power switch: Power Off, Dial, VCG, Fast, Medium and Slow (Sweep).

A red disc affixed to the mode control shaft "lights up" a small hole in the control panel when the unit is turned on. Very economical on batteries, and quite effective!

The dial mode allows the unit to be used as a conventional audio generator, with the output frequency selected by the dial setting and the range switch. Selecting the VCG mode allows control of the frequency output via an external voltage, applied to terminals on the rear panel but dependent on the range switch setting. Full scale frequency change requires approximately 1.8V input.

A choice of the three sweep modes gives sweep times of 2.5, 250 milliseconds or 25 seconds.

Perhaps the most interesting feature of the Model 30 is that the sweep function can be linear or logarithmic, i.e., a linear change of frequency with time or logarithmic—so many octaves per unit time. The log sweep is particularly convenient when testing audio equipment.

The logarithmic function can also apply to the external control function of the voltage controlled oscillator—the circuit contains a "log converter", actually one transistor, which gives a logarithmic response to any control voltage applied to the VCO.

This means that even the dial can also give a logarithmic control of the frequency output. When in the linear mode, the dial calibrations show a frequency range of 10 to 1 whereas when the log positions of the range switch are selected, the dial gives a 1000:1 frequency range.

For linear operation, the dial calibrations are accurate to within ±2% of the range. For log operation, the dial markings are a guide only and accuracy is not specified.

While the sine wave output is variable in amplitude up to a measured maximum of 1.2V RMS, the square wave output is fixed with a low state between 0 and +0.5V while the high state is between + 3 and + 5V, depending on the battery condition. Duty cycle of the square wave is an approximate 50%. A fixed amplitude triangle wave output is available on the rear panel at approximately 1V peak-peak for less than 2mA peak current.

Sine wave distortion is quoted at less than 2% from 20Hz to 20kHz. We made a typical measurement at 1kHz which resulted in a reading of less than 0.4%—a commendable value for this sort of circuitry. And there is no sign of any spike or discontinuity at the peaks of the sine wave, as commonly occurs in function generators which shape the sine wave from a triangular waveform.

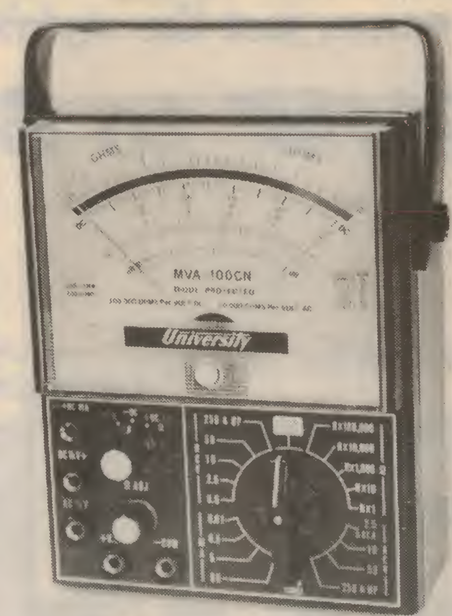
A detailed instruction manual, containing circuit and PC layout, is provided with the Model 30. It also outlines some of the uses to which the unit can be put and gives a trouble-shooting procedure for fault finding.

In summary, the Wavetek Model 30 is a thoughtfully designed instrument with potential applications in most laboratories and workshops. Price, including a nickel cadmium battery and mains charger is $219 duty paid, plus sales tax where applicable.

For further information on Wavetek instruments, contact the Australian distributors, Kenelec Systems Pty Ltd, 142 Highbury Road, Burwood, Victoria 3125, **or interstate offices. (L.D.S.)**

NEW PRODUCTS

University MVA-100CN Multimeter



A large multi-scaled and mirror-backed meter is the main feature of the MVA-100CN. The scales are well chosen and in different colours to make them easily distinguished. Of particular interest is the OHMS scale. With a centre-scale reading of 8 ohms combined with the five multiplier positions on the range switch, the unit can make accurate measurements of resistance from less than 0.5 ohms to over 50 megohms.

In fact, the ohms scale calibrations provide for readings from 0.1 ohm to 200 megohms.

Sensitivity on DC voltage ranges is 100,000 ohms per volt, while on AC voltage ranges it is 10,000 ohms per volt. When switched to the 250V DC range, it puts less load on the circuit being measured than an electronic voltmeter with an input impedance of 10 megohms.

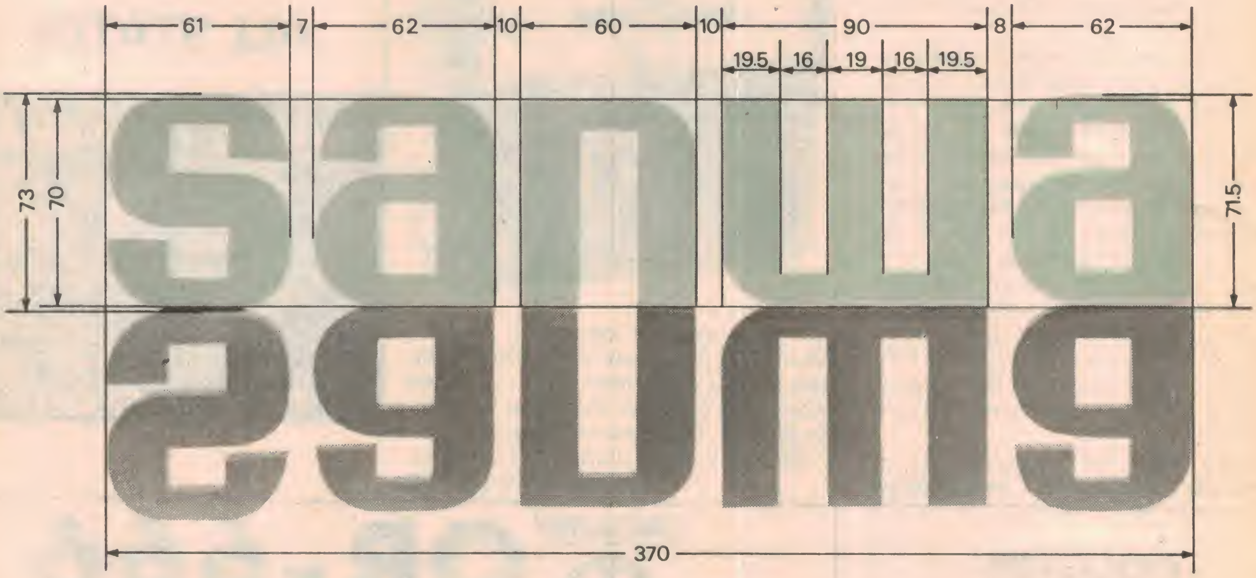
DC voltage ranges are 0.5, 2.5, 10, 50 and 250V FSD. In addition, there is a separate jack for 1kV FSD or 25kV with an accessory probe. AC voltage ranges are 2.5, 10, 50, 250 and 1kV via the separate socket on the front panel. The 2.5V AC range also doubles as the 10 amp AC range which uses an internal current transformer.

Current ranges for DC are 0.1, 0.5, 5, 50 and 500 milliamps FSD and 10 amps FSD via a separate input jack. All told, there are five separate input sockets designed to accept 4mm jacks. A mode switch selects one of three positions according to the desired measurement: + DC, AC volts or ohms; −DC; and AC

Continued on page 105

The name's the same, just the style's been changed.

From SANWA to sanwa



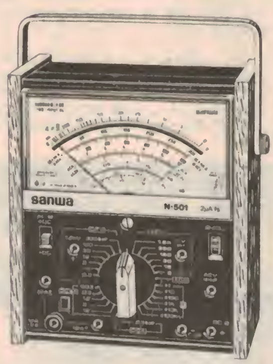
Why the change?

Because besides being more attractive, we think the new style presents a sharper image of precision. And precision is what Sanwa is all about.

For thirty years now we've been manufacturing precision measuring instruments. For customers throughout the world (in over a hundred countries, so far). For service engineers, researchers, radio hams—in fact for all kinds of people and companies involved in electronics.

Seventy per cent of all multitesters sold in Japan carry the Sanwa brand. Which isn't really surprising, since Sanwa multitesters have exceptional built-in capabilities. Versatility is a standard feature. So is sensitivity. And there are more than twenty-five models to choose from.

Sanwa: the name that's synonymous with precision.



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amps. A small knob is also provided for adjusting FSD on the ohms ranges.

Measurement accuracy on the DC voltage ranges was very good and well within the 2% of FSD claimed. Similarly, the AC ranges checked out at well within the 3% of FSD claimed.

Frequency response of the AC voltage ranges varied according to the range selected: On the 2.5V AC range it was within 1dB from 3Hz to 300kHz; on the 10V AC range, within 1dB from 3Hz to 300kHz but with a 3.5dB peak centred on about 140kHz; and on the 50V AC range (the highest checked) it was within 1dB from 3Hz to 100kHz with a rising response above that.

Thus for general purpose audio measurements, the MVA-100CN can be very useful. Its decibel scale has calibrations from minus 20dB to plus 10dB, and this together with the table of dB increments to be added when switching up ranges makes it even more attractive for this purpose.

A 90-day guarantee is applicable, while University Graham state that they can provide a 24-hour repair service when necessary. They also have ample supplies of spare parts.

Taking into account its favourable price, the MVA-100CN must be considered a very good buy for those who want a multimeter with comprehensive ranges and a large meter movement.

Supplied with batteries and instructions, the MVA-100CN is priced at $35.00 plus 15% sales tax where applicable. Optional extras comprise a leather case at $6.00, a 25kV probe at $25.00 and a temperature probe at $12.00—all plus 15% sales tax.

For further information, contact University Graham Pty Ltd, 106 Belmore Road, Riverwood, NSW 2210 or radio parts wholesalers. (L.D.S.)

Metalwork for EDUC-8

A complete set of metalwork, including a photoetched front panel, has recently been made available for the EDUC-8 microcomputer. Interested readers should contact the manufacturer, Wardrope and Carroll Fabrications Pty Ltd, PO Box 330, Caringbah, NSW 2229. Telephone 525 5222.

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All current models, fully guaranteed. Now available at our new low prices.
Standard Model, 4 speed ceramic cartridge, sapphire stylus $32.50
As above with cueing device $35.00
Deluxe model with 11in turntable, cueing device, stylus pressure and adjustment also player spindle, ceramic cartridge, diamond stylus $39.00
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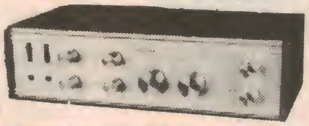
Pack and post NSW $1.45
Interstate $1.80
Beautiful teak or walnut pre-cut mounting base $12.50
Tinted, fully moulded perspex cover $10.50

SONATA NS-1600D



All silicon solid-state Hi-Fi Stereo Amplifier. 10 watts RMS per channel. Each channel has separate Bass Treble controls. Inputs for magnetic or ceramic cartridge, crystal mic, radio, tape—tape out, stereo headphones, 8-16 ohms instruction booklet circuit supplied. Timber cabinet. Dimensions 14½" x 8" x 4".
$74.50 plus freight **$2.50**.

GARRARD

Model SP 25 Mark 4, the newly released latest model—a beautiful machine. 3 speed, 4 pole motor. Aluminium turntable. Fully balanced and CALIBRATED P.U. arm. Bias comp. cue & pause control. Click suppressor. Auto. set down.
Including Mag. Cartridge, Dia. Stylus $75.95
Pack & Post N.S.W $1.50. Interstate $2.50.

KAISE MULTI—TESTERS

MODEL SK-44 30,000 OPV DC 10,000 OPV AC
Specs. DC Volts—0.6, 3, 12, 60, 300, 600, 1200, 3000. AC Volts—6, 30, 120, 300, 1200. DC Current—30uA, 6mA, 60mA, 600mA. Resistance—10K, 1MEG, 10MEG, 100MEG. Decibels—20 + 17, 31, 43, 51, 63dB. Double Jewelled Meter with Mirror Scale. Overload Protected. Circuit Diagram.
$24.50. P&P $1.00

MODEL SK-20 20,000 OPV DC 10,000 OPV AC
Specs. DC Volts—0.25, 2.5, 10, 50, 250, 1000. AC Volts—10, 50, 250, 500, 1000. DC Current—50uA, 25mA, 250mA. Resistance—7K, 700K, 7MEG. Decibels—10 + 20/10V + 20 + 36/50V. Double Jewelled Meter with overload protection circuit diagram.
$18.95. P&P $1.00

PLAYMASTER 143

High Performance 12.5 + 12.5 Watts Stereo Amplifier. For Full Particulars Ref. Sept./Oct. 74 Issues EA.
Complete Kit Top Quality Components $72.50. Fully Constructed, Thoroughly Tested $87.50.

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240V AC 30 watts, lightweight 2½oz, heating time 1.8 mins. **$8.50**

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Black Vynex Covered Cabinets Rugged and Attractive, Innerbond Lined for Richer Sound. Excellent Frequency Response. 8 or 16 ohms. Three Models.

15W RMS	25W RMS	40W RMS
2 x 8" Speakers	4 x 6" Speakers	4 x 8" Heavy Duty Speakers
Size 19½"H. 11"W. 7"D.	33" x 10" x 10"	37" x 11" x 10"
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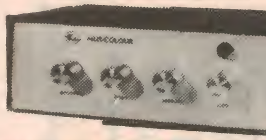
BSR STEREO PLAYER MODEL P-128

Latest design 4-speed auto or manual operation. 11in heavy weight diecast turntable driven by fully shielded 4 pole dynamically balanced 240V motor. Noise suppressor. Silicone damped cueing device. Square section brushed aluminium pick up arm. Adjustable counterbalance. Calibrated stylus pressure control. Antiskate bias compensator fitted with magnetic cartridge, diamond stylus **$55.00**
P&P $1.50

MUSICOLOUR II

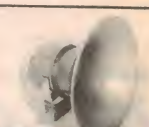


Operates in conjunction with your home Hi Fi or P.A. System, and as the music plays, different coloured lights respond. The Musicolour II has three channels. The max. number of coloured lights is not to exceed 1500 watts per channel.
As per EA Dec '71, Jan '72. Complete kit of parts $55.50
Fully constructed $65.50
Pack & Post 75c

TWEETERS

New Plessey 3". Kc3DX/8 1.5-19khz 10w P&P 60c $2.95
Magnavox 3TC MK2. 8 or 15 ohms, 5-18 khz. 15w. P&P 60c $3.95
Tesla Hi Power, 4 ohms. 5-15 khz P&P 60c $2.95
Plessey X-20 Hi Power Horn Tweeter. 8 ohms P&P 60c $10.95
Philips 1" Dome AD 016/T8

PA SPEAKERS



8 watt 8" Heavy Duty High Efficiency Speaker in Waterproof projection flare 8 or 15 ohms $24.95

MAGNAVOX 8/30 SYSTEM TEAK OR WALNUT

Acknowledged by electronic magazine review critics as tremendous quality and value for money. Cabinet size 25½"H x 15½"W x 12"D Capacity 1.6 cu/ft. Fully lined with 1" thick heavy weight innerbond acoustic packing. Freq. response — 30Hz — 18,000 Hz ± 6dB. Power — 30 Watts R.M.S. system sensitivity 98dB.
Systems will be carefully packed and despatched anywhere (too heavy for post). Complete system 8 or 15 ohms.
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Twin 7/010 Speaker Flex with Stripe $8.75 per 100 yds. 90c P&P
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50 WATT SOLID STATE GUITAR AMPLIFIER

50 watts RMS solid-state guitar amplifier. PM125 4 inputs, 2 channel with separate volume, bass and treble controls; speed and intensity controls for vibrato. Remote foot switch with plug and lead. Black vynex carry cabinet. Fully constructed and ready for operation off 240VAC **$125.50**

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B.C.221 Freq. Meter Less XTAL. Valves. Book Excellent condition. $12.50
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3" Indicator unit with 3BPI CRO Tube and many useful valves $15.00
5FP7 for SSTV in housing with deflection coils $15.00
Plessey C42.36-60 Mhz. $45.00
Plessey B47. 240 VAC $85.00
Plessey B47. 24V DC $70.00
NEW AWA Sig. Gen. 140-300 Mhz $37.50
Cintel Demonstrator Oscilloscope 12" 240 VAC Suit school $175.00
ARC-49 2 metre TX $15.00
3BZTX. 3-10 Mhz 12V DC $7.50
½" and ¼" DIA. 72 ohm. COAX. 30ft length $2.00
No. 88 TXRX.38Mhz FM Pack Set $17.50
New Oil filled Cond. 15 UF. 1000V DC. 10 UF. 1500V DC ea. $3.50
25 UF. 440V AC $3.50
4 UF. 600V DC $2.00

LOW NOISE CASSETTES IN HARD PLASTIC PACK

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All with 240V AC 50 cps. Primary
220-0-22 50MA. 6.3V2A $3.50
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0.2 MH $1.65 P-P 35c
0.5 MH $1.85 P-P 35c
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NEW VALVES

Out they go at bargain prices 25 for $3.00 P&P $1.50 1L4; 1H4, 1Q5, 1J6, 1H5, 3Q4, 3A4, 6x5, 6K7G, 6C8G, 6BL7, 6F6G, 6J7G, 6K4, 6SJ7, 6K6GT, 6AK5, 6AC7, 6B4, 6AR6, 6AD4, 6AN5, 6BA5,6BF6, VR54=6H6, VR53=EF39, VR55=6B6, VR57=EK32, 12A6, 9006, 7C5, 7W7, X65, EL32, 76,77,89V, CV63, VR101, AR8, ARP12, CV1331 = VP23, CV1306 = HL23, CV65=PEN, 25, 954, 956, 1S5, 6A6, 6SC7 10 for $3.00 + 80c P&P. IT4, IR5, 6 AM5 6AM6, 6J6, 5 for $3.00 *5z $1.00 P&P. ECH35, 807, 6G8G, 6BQ7, 6B8, 866&866A, 100th 3E29,815* $3.00 each P&P 80c

MAGNAVOX WIDE RANGE TWIN-CONE SPEAKERS

8-16 OHMS 30-16,000Hz
6WR MK5 12W RMS $9.90
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10WR MK5 16W RMS 65c $11.50
12WR MK5 16W RMS $13.50

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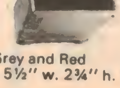
Presents the Vibranto Series 15" x 100 watt Electronic Musical Instrument Speaker especially designed to reproduce the big sound of the BASS GUITAR, STRING BASS ORGAN. $89.00

PLASTIC INSTRUMENT CASE



Blue, Green, Grey and Red
Mighty tough. 5½" w. 2¾" h. 5" d. $3.35
P&P 55c

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Rola C96LX Twin 8 ohm Oval $5.50
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Magnavox 6PIXX 8/15 ohm Twin $4.95
Magnavox 8JX 8" Twin 27 ohms $5.50
Pack and Post 85c

The Amateur Bands

by Pierce Healy, VK2APQ

Wicen—a valuable organisation

Amateurs throughout the world are, when needed, prepared to give their services to the community. Recently in Australia, through WICEN, amateurs proved their worth. However, the potential and initiative of this organisation is not fully realised or appreciated and little encouragement seems forthcoming from within some administrative bodies.

More information to hand relating to the work of amateurs, following the Darwin cyclone, highlights the assistance the Wireless Institute Civil Emergency Newtork and individual amateurs gave during the crisis period. Yet, it is also evident that the potential of this voluntary organisation is not realised by some government administrative officers, and that unnecessary restrictions are imposed by regulations governing the amateur service. When an emergency arises, delays in giving official approval or the withdrawal of approval can cause confusion and conflict of opinion.

The time to review the role of amateurs during an emergency is now, while the memories of the Darwin disaster are fresh in the minds of administrative officials and amateurs alike.

The first WICEN network to make contact with Darwin on the 25th December, 1974 was the North Queensland net, activated by members of the Cairns Radio Club. It remained in operation until 1825 EST on the 31st December.

From Ted Gabriel, VK4YG, WICEN co-ordinator North Queensland, a resume of events during that fateful period has been received. It provides additional information to that published in last month's notes.

On Christmas morning at approximately 1055 EST, Ted had a contact with VK8RR/Mobile, Bob Hooper, manager of OTC station VID Darwin. Ted was able to arrange for Keith Parker—VK4VI, manager of OTC station at Cairns, to come on the air on 14175kHz to discuss the situation at Darwin with VK8RR/Mobile. This contact continued until Bob Hooper went aboard the "NYANDA" as officer in charge to operate VID2 from the vessel berthed at the Stokes Hill wharf.

At 1115 EST, in order to ensure a clear channel on 14175kHz for VK8RR/M and VK4VI, Ted activated WICEN and, as co-ordinator for North Queensland, assumed net control.

A contact was also made with VK2BNN/8—VK8JT and WICEN net control was then assumed by VK3AH in Melbourne. Other stations to check in with WICEN control Cairns were VK8OM Owen Marshall at Koongarra, about 185 kilometres east of Darwin and VK6NA Reverend Father Basil at Kolumburu Mission, WA—both with information about their areas. VK6AI Neil Marks operating portable at Kuri Bay WA also reported that a Japanese fishing boat, presumed missing, had reported to Broome radio that it was safe.

During the afternoon and early evening of the 25th December a considerable amount of official traffic was handled. Poor band conditions required Cairns control to relay traffic to Melbourne.

On December 26th, North Queensland WICEN provided the only communication link with Gove through VK8KG Keith Goshing. Official traffic was handled. VK4YG, the WICEN station Cairns, was authorised to handle National Disaster Organisation traffic from Canberra to Darwin for General Stretton's HQ in Darwin.

December 27th was a very busy day for the national WICEN and Cairns networks with a large volume of traffic concerned with: NDO; Police; Dept. of Social Security; aircraft movements and load details; Salvation Army; Red Cross; cyclone synoptics and weather.

Official approval for WICEN operation was then withdrawn, but a telegram from the Darwin operators to the Postmaster-General had this order revoked. The network continued to handle third party traffic mainly of a compassionate nature, to do with the welfare and whereabouts of evacuees, during the 28th and 29th December. Then official approval was again withdrawn.

Following a reminder that Gove and Koongarra were still without communication, other than by that provided by North Queensland WICEN in Cairns, permission was given for that net to continue operations in conjunction with the Cairns State Emergency Services. This network continued to operate until 1825 EST on 31st December, 1974—a total of seven days operation.

The call signs of some of the stations who were active in the North Queensland WICEN net were: VK4HM; VK4TL; VK4AE; VK4YG; VK4NU; VK4OV; VK4WIT; VK4PS; VK4LZ; VK4RR; VK4HE; VK4DK; VK4ZEZ; VK4ZIP; VK8KG; VK8OM; VK8JT; VK2BTS/4; VK2BNN/8; VK2BYL/8.

There were many others monitoring the channel and ready on standby, had their services been required.

In a note accompanying the resume of the activities, Ted's comments as North Queensland WICEN co-ordinator were:

". . . I am very pleased with the performance of WICEN here in North Queensland and that the years of planning and 'beating the drum' have paid off in such a manner as to win praise from all sections of the community and some very good publicity for amateur radio generally. Both the Cairns and Townsville clubs did an excellent job during the emergency. To all amateurs who participated in the area I express my thanks."

At the time of the emergency, Ted Gabriel was acting signals commander, State Emergency Service in Cairns and was able to run a joint WICEN-SES operation from the Cairns headquarters.

In Brisbane, Sydney, Melbourne, Adelaide, Canberra, Perth and several other centres, WICEN stations operated or were on standby, handling or relaying official traffic to various authorities.

From an interim report on the Darwin disaster communications, published in the WIA magazine "Amateur Radio", the following brief extracts relate to major operational aspects of the network in Melbourne.

At 5.30pm on the 25th December, 1974, initial contact was made with VK2BNN/8-VK8JT by VK3AH who, with VK3UV maintained contact with Darwin for approximately 25 hours, relaying traffic to the Victorian Police communications centre "D24", initially by telephone and later by police UHF link, until relieved at 5.47pm on the 26th December.

As WICEN control station, VK3AUP took over the net and continued to handle police, and NDO traffic until 3.45pm on the 28th December when the call sign was changed to VK3WIA, the official station of the federal executive of the WIA.

At this stage permission was given to handle third party traffic of a welfare nature. Operations handling traffic of that nature continued until midnight on the 29th December, 1974—the fifth day of operation.

Among amateurs there is a feeling that, in cases of emergency, more latitude should be given in the type of traffic allowed to be handled and separate nets set up earlier for welfare type of traffic.

Maybe, the experience gained during the fateful Christmas 1974 will result in amateurs in general and WICEN in particular, being more widely recognised as an efficient communication organisation, prepared at all times to give assistance when needed.

To attain such a goal it is necessary for amateurs to actively support WICEN.

Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent direct to Pierce Healy at 69 Taylor Street, Bankstown 2200.

LOCAL & OVERSEAS NEWS

AMATEUR TELEVISION: Excellent progress has been made by amateurs in the Gosford and Sydney areas with colour television transmissions. A report on the activities in the Gosford area is given in the Central Coast Amateur Radio Club notes.

In Sydney, Vic Barker, VK2ZVV/T and Ian MacKenzie, VK2ZIM/T are making colour transmissions each night from 1900 hours EST till 2330 hours EST.

The transmissions originate from Paddington, an inner Sydney suburb, beaming north. The vision frequency is 442.3MHz, with sound on 447.8MHz, and the PAL colour system is used. The transmitter uses a 4X250B with an ERP of 12kW for vision and 600 watts ERP for sound. The antenna is a 64 element phased array.

Vic and Ian may be contacted on Sydney telephone number 31 7769 after 7.00pm. Reports on reception would be appreciated.

INTERNATIONAL TELECOMMUNICATION UNION: For amateurs and those engaged professionally in electronics and communications, the ITU publication "Telecommunication Journal" contains many interesting articles on the latest developments and achievements associated with communications.

The journal is available either in English, French or Spanish language. Subscription, by surface mail is 50 Swiss francs a year. Price for a single copy is 5 Swiss francs.

The Telecommunication Journal may be obtained from the Sales Division, International Telecommunication Union, Place des Nations, 1211 Geneva 20 Switzerland.

To recall the anniversary of the signature in Paris of the first International Telegraph Convention in 1865—110 years ago, the 7th World Telecommunication Day will be celebrated on 17th May, 1975.

The theme of the celebration will be "Telecommunications and Meteorology" and was chosen by agreement with the World Meteorological Organisation.

ACT DIVISION WIA: The annual general meeting was held at the Studio, Griffin Centre, Civic, on Monday evening 24th February, 1975. The council elected for the ensuing year includes; President, Ted Pearce VK1AOP; Vice-presidents, Rex Roseblade VK1QJ, Harry Vonthethoff VK1KW; Treasurer, John Roberts VK1ZAR; Secretary, Eric Piraner VK1Ep; Committee, Eddie Penikis VK1VP, Phill Bowers

AMATEUR BANDS

VK1YS, Andrew Davis VK1DA; Federal councillor, Eddie Penikis VK1VP.

Commencing at 6.30pm each Tuesday night in Room F1, at the Woden Valley High School, AOCP classes will be conducted. The class will consist of 30-minute Morse Code practice, followed by a two hour theory session. Fees are $50 payable in full on enrolment, or in two instalments, the first being $30 on enrolment and $20 payable at the beginning of June.

For details write to the Secretary, ACT Division, WIA, PO Box 1173, Canberra City, ACT 2601.

RADIO CLUB NEWS

ILLAWARRA BRANCH NSW DIV. WIA: Good progress has been made on the repair and reassembly of the 432MHz moonbounce equipment damaged by a lightning strike during October, 1974.

The transmitter has been completed and checked out on a dummy load. An output of 350 watts was obtained, which is an improvement on previous output. A fine gesture on the part of Cor Mass, VE7BBG and Joe Reisert, W1JAA (ex W6FZJ) in sending replacement FMT4575 transistors and coaxial relay as Christmas presents was very much appreciated. This allowed the preamp and postamp to be completed. Noise figure checks, made with the assistance of the CSIRO, showed that the original figure of 1.5dB was achieved.

A quarter-wave coaxial filter has been constructed for installation immediately ahead of the preamplifier. Its main purpose is to increase the selectivity of the very broad-band (50MHz to 500MHz) preamp and postamp, thus alleviating the effects of strong signals far removed in frequency from 432MHz and reducing the possibility of damage to the transistors by lightning. The attenuation of this filter is extremely low at less than 0.2dB.

A modification to the preamp, using the W6FZJ

Circards:

Due to heavy reader demand for Wireless World Circards, many parts of the series are now out of stock. As there are no immediate prospects of obtaining fresh stocks, we cannot accept new orders except for those parts listed below.

Some of those listed are almost exhausted, so please indicate your second preference.

Still available:

No. 4 — AC Measurement
No. 8 — Astable Circuits
No. 10 — Micropower Circuits

"Ultra low noise" circuit gave a further slight improvement in the system noise figure (0.1dB).

It was anticipated that VK2AMW would be operational for participation in the special moonbounce tests on 144MHz and 432MHz by the Stanford University Research institute group (WA6LET) in the USA on February 22nd and 23rd, using their 45-metre dish antenna.

Later it is intended to rebuild the power amplifier stage of the transmitter using the K2RIW parallel tube circuit. This will give a 3dB increase over the present transmitted power and bring the transmit capability of VK2AMW closer to the receive capability.

A comprehensive equipment and operating status report for VK2AMW has been compiled and forwarded to K2UYH for publication in the 432MHz EME Newsletter.

Details of the VK2AMW dish antenna and feed system have also been included in a recent publication—successful 432MHz EME Antennas—produced by EIMAC of USA.

This report was compiled by Lyle Patison, VK2ALU moonbounce co-ordinator of the Illawarra Branch, and appeared in the monthly newsletter of the branch. The newsletter has been given the title "The Propagator".

GOLD COAST RADIO CLUB: AOCP classes are conducted every Monday evening (except Q'land public holidays) for members of the GCRC at the home of Athol Roberts-Thompson, 40 Australia Avenue, Broadbeach. Starting time for classes is 7.30 pm. Full details from the secretary, PO Box 588, Southport 4215.

Plans are being made for a repeater only contest. The object of the contest will be to make as many contacts as possible in a specified time through the GCRC channel 1 repeater. The contest will be over four one hour periods, not necessarily consecutive.

There will be two sections in which any amateur or shortwave listener may enter: (a) One hour, (b) Two hour. It will be mandatory to use correct repeater operating procedure. Scrutineer stations will be appointed to log breaches which will mean deductions from the score of your entry.

Listen to the Gold Coast Net conducted by VK4WIG every Sunday evening at 7.30 pm on repeater channel 1 and at 8.00 pm on 3650KHz for further details.

MAITLAND RADIO CLUB: Technical classes of instruction in radio and electronics as applied to amateur radio are conducted at the clubrooms in Maize Street, Tenambit, each Friday night. Classes for beginners commence at 7.00 pm. Besides the classes, the club has several other technical interests for members. These include visual aid photography, tape recording and announcing, motion picture projection, home movies and amateur radio.

Preparations are also under way for the major field day to be held at the club on 6th April, 1975.

MOORABBIN AND DISTRICT RADIO CLUB: Meetings are held on the 1st and 3rd Fridays of each month at the Moorabbin Baseball Club Rooms, Summit Avenue, Moorabbin, at 8.00 pm. An interesting program of activities has been arranged for the year, the first Friday of the month being a "natter" night and the third devoted to a lecture on a technical aspect of radio communications.

Lectures for April and May are:—

—Satellite communications via OSCAR, by David Hull, VK3ZDH, Project Australia co-ordinator, and

—Solid State communication techniques by Les Jenkins, VK3ZBJ.

Visitors are welcome to meetings.

WIA YOUTH RADIO CLUB SCHEME: The NSW division YRCS management committee has co-opted Bob Lloyd-Jones to the position of publicity officer in NSW. It was also agreed that a publicity campaign be launched with the aim to encourage the formation of more YRCS clubs in NSW.

The development and introduction of a workable communication system that would ensure a fast and effective means of passing information between the management committee and clubs, interclub and interstate YRCS organisations is a proposal receiving immediate attention of the committee.

To facilitate the proposal it has been suggested that full use should be made of the NSW YRCS newsletter, on-air contacts between clubs, YRCS news broadcasts, frequent meetings of club leaders, seminars and weekend and vacation YRCS camps.

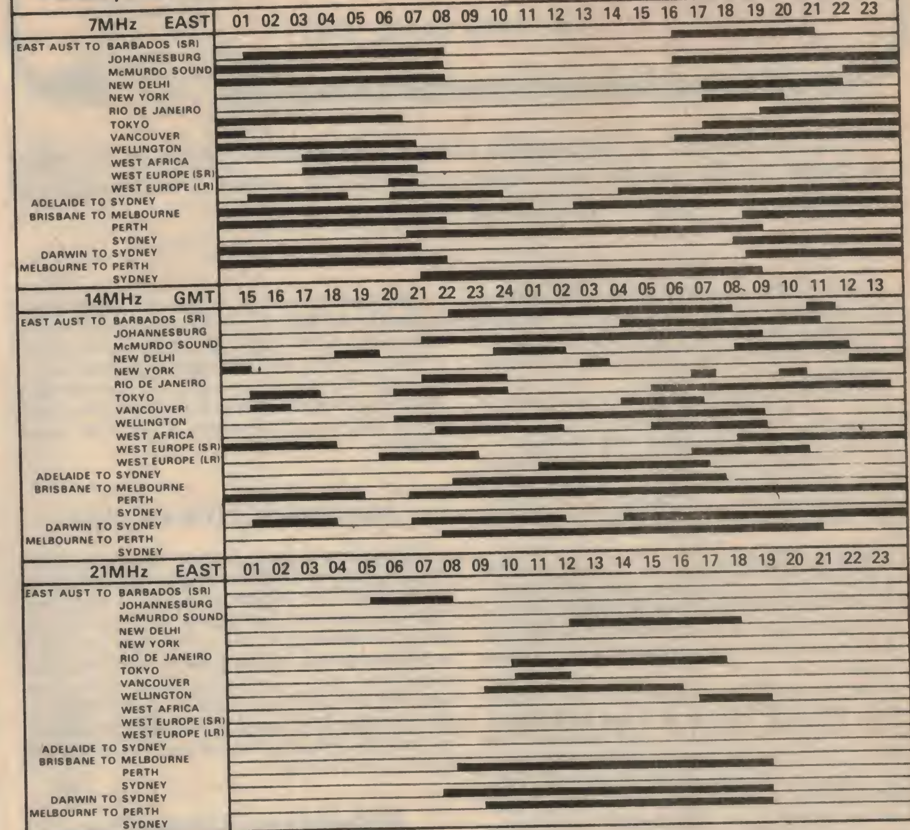
For information on any aspect of YRCS activities write to the secretary, Steven Blair, 53 Market Street, Randwick 2031.

GEELONG AMATEUR RADIO AND TV CLUB: On Friday evening, 24th January, 1975, a dance was held in the Geelong West Town Hall in aid of amateurs in Darwin who had suffered the loss or damage to their radio equipment during the recent cyclone.

The dance, organised jointly by the Geelong Amateur Radio Club and the Geelong Radio and Electronics Society, was well attended. The amount raised was in excess of $650.00.

IONOSPHERIC PREDICTIONS FOR APRIL

Reproduced below are radio propagation graphs based on information supplied by the Ionospheric Prediction Service Division of the Department of Science. The graphs are based on the limits set by the MUF (Maximum Usable Frequency) and the ALF (Absorption Limiting Frequency). Black bands indicate periods when circuit is open. 4.75



Shortwave Scene

by Arthur Cushen, MBE

A rapid expansion of languages used by Deutsche Welle at Cologne has been noted, while new relay stations are under construction to give the station better world wide coverage.

As well as testing its new transmitters at Malta, Deutsche Welle has also been heard testing from Sierra Leone with a 250kW transmitter. Reception has been at 0600GMT on 5980kHz and at 0800GMT on 9630kHz.

The station in Malta consists of the transmitter at Cyclops and the receiving station at Nigret. The transmitting station is equipped with one medium-wave transmitter and three 250kW shortwave transmitters. At the receiving station, Deutsche Welle programs are picked up and passed, via a radio link system, to the transmitting station for re-broadcasting.

In addition, there are the two stations in Julich and Wertachtal in the Federal Republic of Germany, with nine shortwave transmitters of 100kW each and six of 500kW each. This year, two further 500kW transmitters will go into operation in the Federal Republic.

In 1965, a 250kW transmitter was put into service in Kigali in Central Africa to re-broadcast programs for that area of the world. A relay station is also being set up in the Caribbean on Antigua and as from next year, Deutsche Welle programs will be re-broadcast by three shortwave transmitters, two of 250kW and one of a lower power. Future plans include the setting up of a relay station in the Asian area.

COLOGNE USES 3995kHz

Deutsche Welle at Cologne has been using a new frequency in the 75 metre band for its German transmissions to Africa. The station carried out tests on 3970kHz some weeks ago, but is now using 3995kHz for this transmission. Our reception is best around 1900GMT when a news bulletin in German is heard after the station's interval signal.

The transmitter has a power of 100kW and is located at Julich. Transmissions are from 1800-2150GMT, 2200-0150GMT and 0200-0550GMT. There is some interference to Rome Radio on the same frequency, however Radio Free Europe, which formerly used this channel, has now moved to 3960kHz.

Deutsche Welle has also introduced a broadcast in Bengali, its 34th language, and this transmission is broadcast from 0700-0740GMT on 21560, 17825, and 15245kHz.

SAHARA VERIFIES

A verification card together with a book and schedule details has come to hand from Radio Sahara following our reception on 11805kHz. The signals were reported in a recent issue as being received on this frequency from 0800GMT. There were some doubts expressed overseas as to whether this was actually Radio Sahara or a relay transmission of Radio Nacional Espana, which owns the station and operates from Spain and the Canary Islands.

Our verification is proof that the transmitter is located in the Sahara and that shortwave transmissions are now on 7235 and 11805kHz. The power is listed as 10kW, but there have been reports from Denmark that the strong signal we are hearing is actually carried on a 100kW transmitter. The address is: The Director, Radio Sahara, EAJ 202-203, Aaiun, Sahara.

SOUTHERN CROSS DX CLUB

The Southern Cross DX Club, founded in June 1973, was formed to promote friendship and co-operation in the hobby of distant reception of Radio and Television stations of all modes, with specific emphasis on developing and maintaining interest in DXing in Australia. Subscription to the Club and a monthly 8-foolscap paged magazine is $3.00 in Australia. The Adelaide club members meet monthly on the 3rd Friday. All enquiries are welcome to Secretary, Mr John Pickering, 23 Vinall Street, Dover Gardens, South Australia 5048.

ENGLISH FROM DAMASCUS

According to Sweden Calling DXers, two English programs are broadcast each day from Radio Damascus in Syria, which has extended its Foreign Service. Damascus is now using 6200kHz (although continues to announce 7105kHz), during the morning period. Programs are as follows: 0500GMT Hebrew, 0630GMT English, 0700GMT French, and 0730-1030GMT classical music announced in Arabic. The German programs are now broadcast by Radio Damascus from 1930-2000GMT on 9655kHz. Listeners mail is answered on Wednesday. The English service is on the same channel from 2030-2200GMT.

OSLOW'S NEW CHANNELS

Radio Oslow in Norway is now using some new frequencies for its world wide broadcasts, and these include 11870 and 11895kHz. The frequency of 11870kHz is used for transmissions to North America from 0300-0430GMT and 0500-0630GMT. On Monday, the last 30 minutes of the program is in English. The station is using 11895kHz for programs to Australia and New Zealand from 0700-0830GMT, and from 1900-2030GMT for programs beamed to Africa.

The two transmissions best received in this area are from 0700-0830GMT on 11895, 15175 and 21655kHz and from 1100-1230GMT on 15175, 21730 and 21655kHz.

CLARIN ON 11700kHz

Radio Clarin is now heard regularly in its broadcasts from Santo Domingo in the Dominican Republic on the new frequency of 11700kHz. The power is 50kW and our reception has been around 0230GMT when an announcement in English is given. According to this announcement they operate on 860kHz medium-wave, 4850 and 11700kHz shortwave, and on FM. The transmission suffers some sideband interference from Havana, Cuba, on 11705kHz after 0300GMT. It is understood that the transmission on 11700kHz is only for part of the day with 24 hour operation being carried on 4850kHz. This latter frequency is being received around 0800GMT.

The station confirms reception with a letter and pennant. The introduction of English announcements will ensure easier identification by most readers.

LISTENING BRIEFS
EUROPE

PORTUGAL: Major changes have taken place in transmissions from Lisbon Portugal, and we have observed the home program broadcast on 9630kHz at 0800GMT. From the BBC Monitoring Service we learn that the schedule is 0515-0930GMT on 6025, 9630, 9740, 11935, and 17740kHz.

BULGARIA: According to Frendx, Radio Sofia has 2 500kW SW transmitters under construction near Plovdiv for Foreign Service broadcasts to Africa, Asia and Latin America. They will be operational towards the end of this year.

FINLAND: The Finnish Broadcasting Corporation has purchased new equipment from Radio Sweden to enable its 100kW transmitter, at present used only in the 19 and 31 metre bands, to be used in the 49 metre band. Also, a new directional 49 metre band antenna is being constructed at the Pori SW Station.

AFRICA

ZAMBIA: The External Service of Radio Zambia has been heard in New Zealand on 4950kHz, replacing 4955kHz, according to the New Zealand DX Times. The transmission is beamed to Rhodesia from 1600-1700GMT, to South Africa from 1700-1800GMT, to South-West Africa from 1830-1930GMT and to Mozambique from 1930-2000GMT. The frequencies used are 4950 and 9580kHz, while the frequency of 6165kHz is used irregularly after 1600GMT.

SAO TOME: Reception of Sao Tome on 5335kHz has been observed in North America. The station is understood to be using the power of 10kW and operating from 0600-0100GMT. This frequency replaces the old one of 4807kHz.

NIGERIA: The Nigerian Broadcasting Corporation regional station at Calabar has been heard by Bryan Clark of Wellington, NZ, with English news at 0600GMT. The station is operating on 6145kHz, and can be heard after Deutsche Welle leaves the channel.

ASIA

YEMEN: Aden has been heard on 7190kHz until closing at 0530GMT with the anthem. The station has recently verified reception with a pink coloured card with full details in English. The verification was signed by R. M. Ahmed, according to John Mainland of Wellington, NZ.

KOREA: The Korean Broadcasting System has been heard by Craig Tyson of Perth, WA, opening at 2000GMT. At this time the station is using 3919kHz for a program in Korean.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are GMT. Add 8 hours for WAST, 10 hours for EAST and 12 hours for NZT.

L.E. CHAPMAN

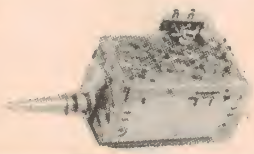
EST. 1940

103 ENMORE ROAD, ENMORE, NSW 2042. PHONE 51-1011
NEW Postage Rates Please Add Extra

TV Picture Tubes. New in cartons 21 inch 110 deg. **$22**, 17 inch 110 deg. **$18**.

TV channel change and fine tuning Knobs **75c** a pair.

TV tuners new in valve type or transistor $10 each.



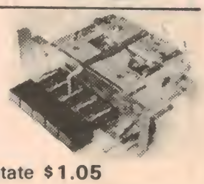
A.W.A. Stereo Amplifier and tuner solid state. 5 Watts per channel $40 Pack and Post $1.50. Interstate $2.

TUNING AND BALANCE INDICATOR METERS **$1.50**

Super special B.S.R. record changer 12 inch turntable balanced arm cueing device etc. $35, pack and post **$1.00**, Interstate **$1.50**.

Portable 4 speed record player 240 volts all transistor **$19.50**. Pack and post **$1**, interstate **$1.50**.

SUIT HOMODYNE TUNER
Car Radio Push Button Tuner
$4.50
Pack & Post **55c** Interstate **$1.05**



SLIDE SWITCH
3 position **50 cents**

Shure M 75/6 Magnetic Pick up Cartridge **$11**.

245V 36C 18V Centre Tap 6.3 windings Photo **$5**

100 mixed condensors micas polyester ceramic **$2** per pack and post **45c**.

Perspex tops for record players size 12 x 9⅜ x 3¼ **$1.50**.

Speakers M.S.P.

12 UAC 8/OHM 30 WATTS RMS	$22.00
12 TACX in 8 or 15 OHM 10 WATTS	$11.00
8 TACX 8/OHM	$8.00
6 x 9 in 8 or 15 OHM	$7.00
5 x 7 in 8 or 15 OHM	$6.00
6½ inch 8 or 15 OHM	$4.50
8 x 4, 8 or 15 OHM	$4.50
6 x 4, 8 or 15 OHM	$3.50
5 x 4 15 OHM	$2.50
4 inch, 8 OHM	$2.75
4 inch large magnet 15 OHM	$3.00
3 inch 3.5 OHM	$2.50
5 inch Tweeters 8 OHM	$3.50
4 MB Tweeters	$5.00
6 inch Dual Cone Tweeters	$6.00
5 x 3 80 OHM	$3.00
5 inch magnavox dual cone 8" 27 OHM	$6.00
8 inch national built in Tweeter	$14.00
rola custom kit 63G x Tweeter C60 woofer cross over and pot	$19.00
MSP 2¾ inch 8 OHM	$200
Magnavox 10 inch 4/ohm	$6
3 inch 8/ohm	$1.50

Indoor TV Aerials Vertical Spiral **$1**

Mixed Tag Strips **50 cents** for Dozen

3.5 to 3.5 Jack Plugs 7 ft. Shielded Cable **75 cents**
6.5 to 3.5 Jack Plugs 7 ft. Shielded Cable **75 cents**

Tape Recorder Heads Transistor Top quality suit most recorders **$5.00**

Speaker transformers 5000 to 15 OHM 5 WATT **$2**

Morganite and IRC resistors 33 valves **$2** per 100 pack and post **45c**.

BSR Ceramic Cartridge Stereo **$4**

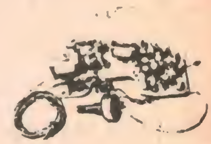
250 mixed screws. BSA, Whit self-tapper bolts, nuts, etc. **$1.25** bag plus **40c** post

Speaker 4 pin plugs **15 cents**

25 mixed 5 and 10 Watt resistors **$2.00**

Hook Up Wire 30 mixed colours lengths **$1** bag.

Amplifiers 5 x 3, 5 x 1½, 5 x 2½, 6 volt complete ideal for record players



50/Ohm Pots ideal for ext. Speakers 50 cents. Transistor and Driver Speaker Transformers **$1.00** pair. Ferrite Rods 6½ x ½ inch **50 cents**.

Pots 30 mixed values including ganged and concentric **$5**

In Line Fuse Holders **20 cents**

Stereo Speaker Wire **12 cents** yard

100 Mixed TV and Radio Knobs including Fine Tune and Channel Change **$5**

Car radio suppressor condensor **30 cents**.

100 mixed condensors micas polyester ceramic **$2** per pack and post **45c**.

Electros 3 in one 100-25-40, 24-250-300, 50-250-300 **75 cents**.

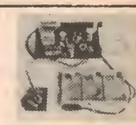
Electros 100 MFD 400 Volts **$1.00**

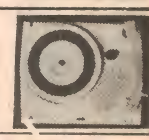
Speaker transformers 12,000 to 15 OHM **$1.25**

½ Meg Double Pole Switch Pots **50 cents**.

Coaxial TV Feeder Cable 75 OHM **30 cents** yard

Transistor 7 Radio ready to use with battery holder **$3.75**





BSR 4 speed 240 V Gram Motor and Pickup $7.95

BSR Stereo Player Model P-128 $52 pack and post **$1.50** Interstate **$2.00**

Stereo Pickup Arm and Cartridge Balanced **$9.50**

BSR Mini Changer 4 speed **$19.00**

Screw in 6 Volt Pilot Lights **$1.50** for 10 Plug-in type 10 for **$1.00**

INFORMATION CENTRE

TV SETS, X-RAY AND MAGNETS: I understand that colour TV sets operate at a higher EHT than do monochrome sets. What is the danger of X-ray radiation? I am also curious as to magnetic effects on the tube face. I have noticed that a powerful speaker magnet placed near the glass of a monochrome TV tube distorts the electron deflection, with an amusing result. The effect disappears when the magnet is removed, but would there be any permanent damage to the phosphor coating, shadow mask, or other part of the circuit in a colour set? Could you tell me if there are any commercial services anywhere in the world on 200 to 400MHz. (M.M. West Perth, WA.)

It is true that valve type TV receivers generated X-rays, mainly in the EHT rectifier, and these were somewhat higher in colour sets. However, they were relatively easy to contain and manufacturers generally had little difficulty meeting the very strict limits set down by the appropriate authorities. With the advent of solid state rectifiers this part of the problem has been virtually eliminated.

As regards the magnet—well, you can play round with it if you want to, but we can't imagine why! The fact is that colour tubes are very sensitive to external magnetic fields, which will upset the very critical convergence adjustments. To minimise the problem, these tubes are fitted with a magnetic shield but, by its very nature, this shield can also become magnetised. To overcome this problem colour sets are fitted with automatic de-gaussing coils, which function every time the set is switched on. This is to remove any minor magnetic effects caused by electrical appliances operated in proximity to the set, or even the earth's magnetic field, should the set be moved.

However, the type of magnetic field you are envisaging might well magnetise the shield and/or the shadow mask to a degree beyond the capability of the set's own de-gaussing coils to neutralise. At best, the cure would involve more specialised de-gaussing such as is normally applied at the factory during manufacture.

Information on the 200-400MHz section of the EM spectrum is not easy to come by. As in Australia, the first 20 or 30MHz are often used for the top VHF television channels. But as for the rest, this seems to be reserved for military and governmental service as far as we can determine. We know of no commercial services from 230-400MHz, certainly.

PRINTED BOARDS: I recently noticed the article on the "Audio Mate" in an old issue and decided to build it. I have gone as far as I can without the printed board, but I am unable to obtain it. Can you tell me how? (R. A., Camberwell, Vic.)

The printed circuit board 71/a8 should be available almost anywhere parts are sold, R. A. Your parts supplier should be able to order it for you. Alternatively, try RCS Radio, 651 Forest Rd., Bexley, NSW 2207.

BROADCAST RECEPTION PROBLEM: Having purchased a farm near Coffs Harbour, I find that broadcast station radio reception during the day is just audible but it is all right during hours of darkness. The nearest stations are at Lismore and Kempsey and these are blocked by the mountains. My receiver is a short-wave/medium-wave valve unit with a 30ft aerial. Are there any means by which I can amplify the incoming signal using one of your projects, or using part of a communications receiver. If not, what modern radio can be used. Would a 50-watt amplifier with tuner be better than a normal radio? (B.T., Hornsby, NSW.)

You have asked a lot of questions in a small space B.T., and unfortunately there are no direct and short answers to them. Firstly, a high powered audio amplifier with a tuner offers no real advantage at all and other ways out should be investigated. Sitting at the desk here in Sydney, we are not in a position to know all the relevant geography of the situation. With this in mind, your best bet might be to ask the local inhabitants as to how they resolved the problem. A preselector in front of an existing tuner may be helpful but this will depend upon such technicalities as signal-to-noise ratio. Even the use of a communications receiver will also depend upon the amount of signal available and so signal-to-noise ratio enters the scene again. Using a sensitive tuner such as our valve unit Playmaster 114 Program Source (File No 2/TU/24), or the transistor Playmaster 139 Program Source (File No 2/TU/33), with a good outside aerial would possibly be your best approach to broadcast reception in your area.

PLAYING CD-4 DISCS: I am writing to inquire about "RCA's Quadra Disc". RCA state on the cover of the record that they can be played on stereo, 4-channel stereo, and CD-4 players. I have read up on quad, 4-channel etc. and find that CD-4 requires a special stylus, cartridge, and demodulator.

If you are unable to complete an "Electronics Australia" project because you missed out on your regular issue, we can usually provide emergency assistance on the following basis:

PHOTOSTAT COPIES: $2 per project, or $2 per part where a project spreads over multiple issues. Requests can be handled more speedily if projects are positively identified, and if not accompanied by technical queries.

METALWORK DYELINES: Available for most projects at $2 each, showing dimensions, holes, cutouts, etc., but no wiring details.

PRINTED BOARD PATTERNS: Actual size dyeline transparencies: $2 each. Specify positive or negative. We do not sell PC boards.

REPLIES BY POST: Limited to advice concerning projects published within the past 2 years. Charge $2. We cannot provide lengthy answers, undertake special research or discuss design changes.

BACK NUMBERS: Only as available. Within last 6 months, face value. 7-12 months, add 5c surcharge; 13 months or older, add 10c surcharge. Post and packing 60c per issue extra.

OTHER QUERIES: Technical queries outside the scope of "Replies by Post" may be submitted without fee, for reply in the magazine, at the discretion of the Editor.

COMMERCIAL, SURPLUS EQUIPMENT: No information can be supplied.

COMPONENTS: We do not deal in electronic components. Prices, specifications, etc., should be sought from advertisers or agents.

REMITTANCES: Must be negotiable in Australia and made payable to "Electronics Australia". Where the exact charge may be in doubt, we recommend submitting an open cheque endorsed with a suitable limitation.

ADDRESS: All requests to the Assistant Editor, "Electronics Australia", Box 163, Beaconsfield, 2014.

SOCKET SPANNER SET

32 piece metric brand new ½", ⅜" + ¼" drive ratchet ext bar, T bar plug spanner etc in metal case only **$5.95** set. Post A 95c, B $1.10, C $1.25, C $1.35.

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3¾in diameter. Will do the same work as the conventional slide rule. Instruction book included from **$1.60 each**
P & P 20c.

P.M.G. TYPE TELEPHONES

Standard desk type with magneto bell calling device. Range 30 miles. Uses standard batteries at each phone. Any number can be connected together on single line.

$26.00
(2 TELEPHONE SETS)

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Sensitive type ex Air-Force, made by Pioneer USA. $37.50.
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1000 ft reels brand new original packing **$4.00 ea.** quantity available
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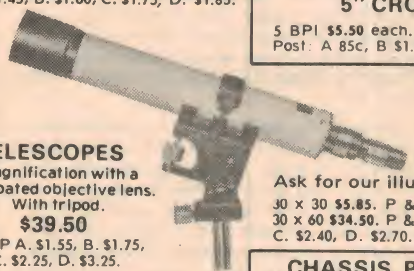

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2-way radio, 7 transistor, PMG approved, set of 2 only **$48.50**

1 watt, 11 transistor $130.00 set of 2.

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3in x 2in containing 2 valves, qty. of resistors, etc.
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Battery operated, transistorised. In good used condition $27.50 Post A 70c, B 85c, C $1, D $1.25.

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A compact and handy tester for workshop or lab where quick circuit checks are required
DC Voltage 5-2.5K (20,000 OHMS per volt) AC Voltage 10-1000V (10,000OHMS per volt) DC Current 0-50 UA. 0-2.5 MA, 0-250 MA. Resistance 0-6 Megohms Capacitance 100 UUF to IUF. Decibels — 20 to plus 22 DB. Complete with instructions.
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SORRY, NO C.O.D.

I have a 4-channel stereogram (NOT CD-4). If I buy any of these records and play them, what damage could I do to either the record, the stylus, or the stereogram?

What is the groove size of the CD-4 records? I, have a CD-4 test record as well as an SQ test record. The SQ test record is excellent. (G.R. Kadina, S.A.)

CD-4 grooves have the same basic geometry as for ordinary stereo records and can ostensibly be played as such on ordinary stereo or matrix equipment. There has been a lot of argument as to whether ordinary pickups and stylii will destroy the additional supersonic information which is peculiar to CD-4 discs. If RCA say it's okay, it probably means that it is so in the average case—not too many playings with not too heavy a pickup and not too worn a stylus. Of course, if it's always to be treated as an ordinary record, it can be played as one, without anyone being any the wiser. Frankly, we would tend to be more conservative in that the basic reason for buying CD-4 records is surely to play them in that mode. Why then put the supersonic content of the signal at risk by playing the records with anything but a CD-4 pickup and stylus?

Stereo decoder . . . from p41

can be rather larger than is really necessary, and this can cause significant distortion of the S-signal components. So try removing these capacitors, and replacing them with new units of somewhat smaller value—say ¼ the original value.

If this seems to give a worthwhile improvement, you can try reducing the values even further, even leaving the capacitors out altogether if this doesn't appear to cause any adverse effects.

The other thing to try is a phase correction circuit inserted between the detector output and the decoder input. The idea behind this is that the main effect of poor IF response is to delay the S-signal components of the stereo signal, relative to the pilot tone. By introducing a circuit to advance the S-signal components in phase, this delay can often be at least partially cancelled, giving a worthwhile improvement.

The type of phase correction network required is shown in Fig. 3. With the preset pot set to zero resistance, the circuit has no effect; as the pot is advanced, a leading phase characteristic is introduced for higher frequencies.

The best way to monitor the effect of the correction circuit is to use either an FM stereo generator of an X-Y oscilloscope display, as before, turning up the preset pot until the best result is achieved. However failing this you could try listening for periods, with various settings.

Using the network of Fig 3 we were able to improve the separation obtained with a low-cost portable from a disappointing 6dB (!) to 30dB, so that it is capable of making quite a difference.

One final way of getting a minor improvement in separation is to connect a capacitor of .0022uF from pin 3 of the XR-1310 to ground. This corrects for a minor phase shift in the device, and in practice seems to be capable of giving an improvement of up to 5dB.

Well, there it is. All that remains is to wish you happy stereo listening!

Marketplace

AIRCRAFT TRANSCEIVER 360 CH & NAV. Narco $450. Hamband transmitter, Hallicraft 370W $275. Transceiver 80 — 10M TRIO 500 & PS, $375. Marina 5CH 2 to 10MHz AM & BC $180. Mobiles for 2M to 150M, various. Folding & rigid towers. We buy & sell all types inc. amateur, two way & aircraft equip. Write Aerospace Services, 3 Broome St, Katanning, WA 6317.

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RECHARGEABLE ELECTRIC TORCH plug in mains. $5.50 pp 50c. ACE CO, Box 24, Elizabeth, 5112.

SCRs TYPE C146D 16 amp, 400V suit CDI, drill controller, etc. $3.40. 81 Noble St, Noble Park, 3174.

COMPONENTS at bargain prices. All new, current stock. ECM Industries, PO Box 309, Hawthorn, Vic 3122.

DIODES: Special off. Stock up on diodes. 1N4004 1A 400V, 10 for $1.30, 25 for $3.00, 100 for $10.00. P&P 25c. Dalby Electronics, PO Box 1, Ermington, 2115.

FERROGRAPH TAPE TRANSPORT Model 6B 3 spd 3 hd 3 mtr. To 8¼" reel. Unused, $90. 15 Whitford Rd, Elizabeth Sth, 5112, SA.

DIGITAL WATCH KITS $132. Digital clock kits $38. 100W RMS audio amp modules $44. Sinclair Project 605 stereo amp kits $87. Also audio ICs, CMOS ICs, coloured LEDs, etc. Write for details before rushing into a purchase. GMR, PO Box 127, Malvern.

COLOUR TVs, used, working, unlimited supplies. 625 line PAL D 25" from $194 plus import. S.A.E. import details, etc. Box 33E, Coramba, NSW 2466.

COMPONENT RESOURCES: A wide range of local and imported parts available at low prices. For an obligation-free quote send a detailed list of requirements to Box 143, PO Camperdown, NSW 2050.

LEDS—stock up on LEDs, large 0.2 in. Complete with mounting clip. Red 35c ea. 10 up 30c ea. Green 45c ea. 10 up 40c ea. P&P 30c. Dalby Electronics, PO Box 1, Ermington, NSW 2115.

FANTASTIC OPERATIONAL AMPLIFIER SALE. 307 TO-5 or mDIP 90c; 709 TO-5 or DIP 85c; 741 TO-5 or mDIP 90c; 747 (dual 741) TO-5 or DIP $2.45; 748 (freq. adj 741) mDIP $1.25. All parts new & guaranteed.
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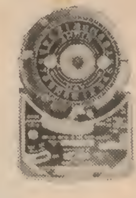

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